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Boundaries and Records

**in the Territory of
Early Settlement from Canada to Florida**

**with historical notes
on the cadaster and its
potential value in the area**

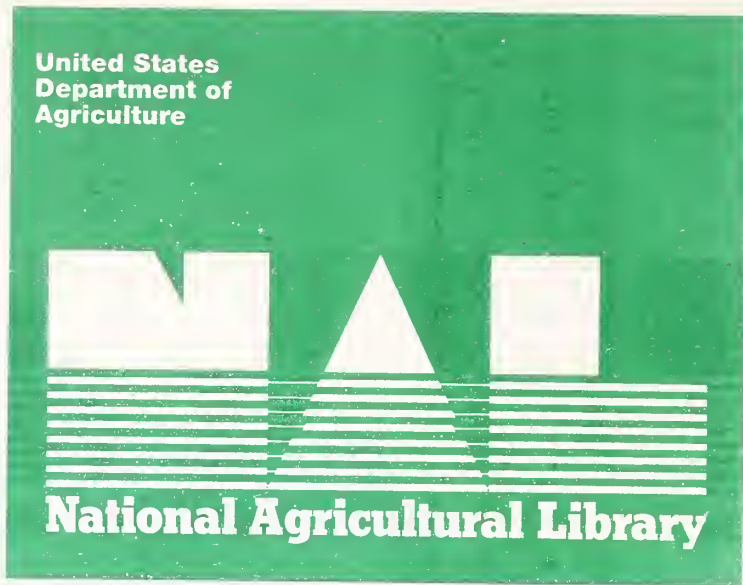
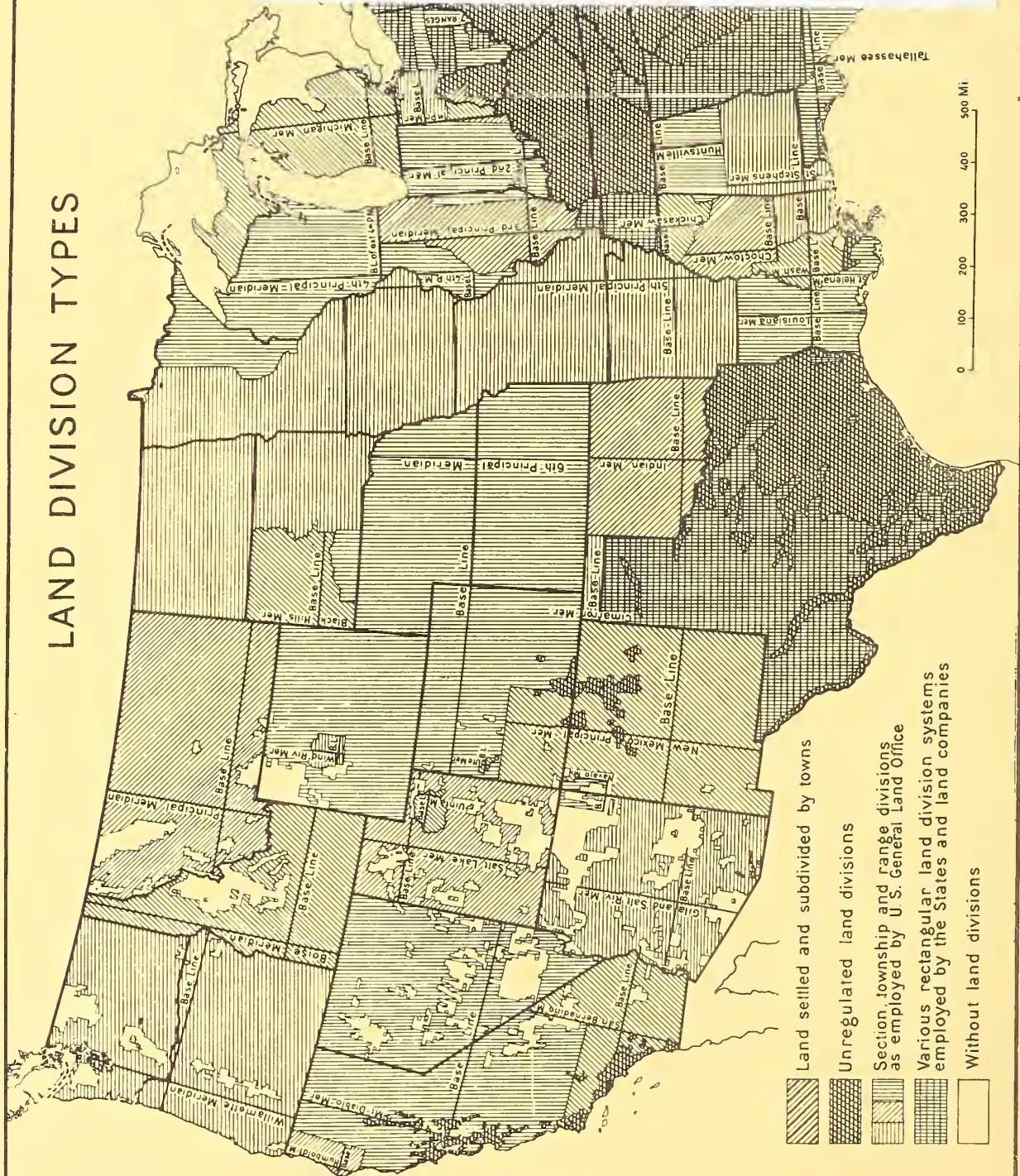
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P R E F A C E

In our time and age when scientific and technical advances are the order of the day, we might also expect the employment of sound scientific principles in surveying and recording the boundaries of land divisions. But this is not always the case. In the United States, an important area out of step with progress in this direction comprises the eastern territory of early settlement.

The States in the eastern territory contain nearly half the population of the country, and as they are located in the humid region, they will need to accommodate more people in the future. Profound changes in settlement and use of the land may be expected. Some changes have been reported. According to the census, in the 1944-54 decade, the harvested crop acreage declined in these States by close to 12 million acres, and the number of farms decreased in the same period by nearly half a million. These are changes in which land use and ownership are involved, and yet for most of the rural area no correlated spatial records are available to indicate the ownership and physical characteristics of the land.

In the public domain States, but not in the Eastern States of early settlement, the system of land boundaries and records is called a cadastral system. This term is derived from the old Roman "cadaster," which means an official register of the quantity, value, and ownership of real estate.

Because uncertain boundaries and disconnected records are an inheritance from the past, they cannot be understood without their historical background. Neither can we hope to benefit from the experience of other countries in which the cadaster was started and developed as a tool of government to solve these problems, without a sketch of its history. In its final form, the cadaster is based on sound principles and is now accepted as the standard remedy. No comprehensive history of the cadaster has appeared so far, and technical improvements are still being introduced. Aerial photography and the State coordinate systems are of this type.

Experience has shown that a properly constructed cadaster offers many benefits to individual landowners, the community, and the State. Security of title, elimination of friction among landowners and political divisions, and a secure foundation for equitable tax assessment are the more obvious ones. A complete set of reliable statistics and maps on the extent, ownership, and quality of the land is another potentiality of the cadaster. Any diagnostic study of the land resources of the region and their development will need such statistics. The cadaster can also provide the background information for community planning recently introduced in some parts of the country. Further, American experience can be of value to underdeveloped countries in their resource development programs. Establishment of a sound and efficient official system of land boundaries and records is essential to orderly economic growth. Therefore, it has many uses. To explain the cadaster as the remedial measure of the boundary and record problems in the Eastern States is the main objective of this study.

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BOUNDARIES AND RECORDS
Eastern Territory of Early Settlement
With Historical Notes on the Cadaster

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SUMMARY

Frequently, land questions in the territory of early settlement are fraught with problems that arise from uncertain boundaries pertaining either to landownership or to political divisions. Many landowners, civil and fiscal administrators, and students of land use problems are directly affected by this uncertainty. Uncertain landlines of private holdings produce for landowners cloudy titles, which affect the value of their properties. Uncertain boundaries are an impediment to proper fiscal administration. When tax assessors are obliged to evaluate real properties without knowing the size and quality of the holdings, arbitrary tax assessments result. Students of regional conditions are handicapped as the determination of areal quantities depends upon definite boundaries, without which any statistical analysis of areal conditions is open to question.

The many uncertain boundaries that exist in this part of the eastern United States are the result mainly of the way in which the country was settled. Settlement in this section of the country is sometimes referred to as the indiscriminate type, in which landlines are derived chiefly from "metes and bounds" surveys.

Uncertain boundaries and indeterminate use potentialities of privately owned land are not peculiar to the United States. Similar situations that prevailed in the Old World up to the 18th century created tensions in the fiscal relationship between governments and people and among the people themselves. The final stage of cadaster development constituted, therefore, a solution of a classical problem that came only after the central principles, on which the solution hinged, were fully recognized and applied.

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The principles involved are partly of the geometric order and apply partly to physical conditions. In the first instance, no definite measure can be obtained of an area for which boundaries are undetermined. When this is applied to land, it means that property or political boundaries must be established on the ground, so that the surveyor can identify their locations and record them in their exact positions on the map or plat. The areal measures are derived from the map or plat that contains the records. The second principle pertains to the use potentiality of the land itself; it is an important factor in determining the value of the land. The quality or use potentiality of the land is contingent upon the prevailing physical conditions, for which were needed classified distinctions that could be represented on maps or plats to correlate them with ownership. This was accomplished by classifying land types or using the soils as the medium of classification.

As a tool of government, therefore, the cadaster is not a recent innovation; it has a long history of evolution. Changes in social conditions, increases in population, more intensive and diversified land use, changes in the form of government, and advances in technology are all contributory factors that affected the fiscal relationship between government and people. In order to establish an equitable tax structure, a revision of the old cadaster system became inevitable. In its advanced form, it is based on horizontally controlled land surveys, an innovation introduced only about a century ago. The soundness of the procedure is so evident that by now all of the countries of Western Europe have adopted it. Additional improvements have been made, especially in regard to the evaluation of property and the adjustment of landownership to present needs.

In contrast to the almost universal recognition the cadaster has received in the Old World as an essential implement of government, it has attracted little attention in the territory of early settlement in the eastern United States. Even in the terminology, although the word "cadaster" is now internationalized, it is not known to the same extent in the United States as it is in the countries of Western Europe. Webster's definition of the cadaster as "An official register of the quantity, value and ownership of real estate, used in apportioning taxes," is a lexical condensation; it indicates fully neither its composition nor its functions. The difference in the use of the cadaster between the Old World and the section of the eastern United States discussed here is undoubtedly connected with its origin. The cadaster was cradled in the Old World and improved progressively with statecraft. Many of the old governments disappeared and new ones emerged with new State boundaries and constitutions. But the new governments did not abolish the cadaster so long as they recognized individual landownership by their citizens. On the contrary, they usually began to review and improve it.

In the New World, the settlers had to start with the acquisition of undivided land. Such land was abundant at first, and the acquisition procedure was not sufficiently regulated. The consequent confusion in land titles was a well-known grievance of the settlers. To prevent its expansion into the unoccupied public domain, in one of its first acts, the Congress adopted the rectangular land-division system. This system now applies to by far the largest proportion of land in the United States. Uncertain boundaries in this area are not the problem they frequently become in the territory of eastern United States that is under discussion, so that the need for a cadaster is not uniformly evident throughout the country.

In the main, the problems of land ownership, land use, and taxation that had to be solved in European countries were similar to those found in the eastern section of early settlement. The unique feature in the evolution of the cadaster is that, although short-cut procedures were at first essayed in these countries in much the same way as we are doing, in the end all of them used essentially the same method of resolving their difficulties. They found from experience that one fundamental method alone promised to supply a satisfactory answer to the question, What are the facts? In short, defining and marking boundaries in the field, surveying and measuring the areal components quantitatively and qualitatively, and keeping records of the results obtained was and is the only reliable method available.

The experience of European countries, therefore, provides a historical lesson. This experience was drawn upon to provide background information and to obtain some insight into the need, development, and operation of a cadaster. What is new is the approach to the solution of the problem by using an advanced technique in mapping and recording the needed features. By using aerial photography, most of the distinct landscape features can be recorded with fidelity. When, by using proper control alinements, as provided by State coordinate systems, the photographs are joined into an aerial mosaic, an excellent working base is obtained. Boundaries of properties, civil divisions, and soil types must be determined or identified in the field, but they can be recorded readily on the mosaic.

The underlying principle, therefore, is still valid. To obtain factual evidence on landownership and on the quantity and quality of the land involved requires integrated mapping to secure a true image of the areal extent, distribution and distinctions, from which valid areal measures can be obtained. It is only the technical procedure - the mapping with aerial photography - that has changed.

INTRODUCTION

Rights and Obligations of Landowners

In free countries, ownership of mobile and immobile property by the individual is usually considered to be one of the basic rights of man. Land, as a homesite and as the medium of production to provide for the corporal needs of man, is considered to be the highest type of property. But how individual landownership developed, that is, how the first owners obtained title to the land was not a uniform process the world over. In feudal society, it was obtained largely as a fief from the feudal lord. In other instances, it resulted from division of the land among the members of a tribe. When colonies were established or unappropriated land was settled, title to the land was obtained either through grant or through purchase from the State. In all instances, organized government, whatever its form, was the initial authority from which valid titles to land were obtained.

Receipt of title to a tract of land marks the beginning of an enduring reciprocal relationship between the landowner and society or organized government. Land-ownership not only endows the owner with certain rights; it encumbers him with sundry obligations. Of the obligations, payment of taxes is the most obvious; it is older than the use of currency as a medium of exchange. In those early days, tribute,

or tax, was paid in kind. Usually, it comprised a stipulated proportion of the products of the land. Much has changed in the intervening 3,000 to 4,000 years, but land taxes have been retained. In fact, taxes on real property, which then were imposed only in the most advanced civilizations, are now a universal government institution. What has changed is the method of assessing and collecting the taxes, which are now based and paid on the value of the property in terms of legal tender. The practice of using real property as security for loans is also an old one. This means that in either instance, the value of the property must be determined.

The rights that go with ownership of real property, however, are not everywhere the same. For instance, whether or not subsurface minerals and water rights are included depends largely on the prevailing code of rights of the country, upon whether it is derived and based on English common law or on Roman law. If the former, ownership rights to subsurface minerals are included; if the latter they are excluded and reserved to the State. Separation of surface from subsurface rights may have been brought about also by owners who formerly owned both but relinquished one and retained the other. Aside from these distinctions, the rights attached to real property have been referred to also as a "bundle of rights" (34, p. 4). ^{2/} According to this concept, not all the sticks in the bundle of rights in land are acquired by the owner. Certain overall rights, which include the rights to tax, to condemn and to police, are reserved to organized government. Nor may all the remaining rights be held by the same party. At times, these rights are divided; the actual owner retains only part of them, while the others are conveyed for a time to a tenant or mortgagee. But no matter of what these estate rights consist, how they are apportioned, or for how long they are conveyed to secondary parties, so long as they pertain to the same tract of land, all these rights have the same horizontal limitations.

The boundaries of landed property constitute the limits to which the owner can exert his authority over the land; consequently, they should be well-established lines marked on the ground. In reality, the boundaries are dividing lines where the estate rights of one owner stop and those of his neighbors start. Inside the bounds of an individual landholding, the owner has dominion authority to decide and control the use of the land, provided the use he makes of it does not conflict with any prevailing local restraints. In this respect, individual holdings may be regarded as the smallest functional unit in the mosaic that portrays the division and distribution of authority within a country.

Boundary Functions

In contrast to the authority retained by the individual landowner, government authority has so many ramifications that not all of it can be exerted by one person or centered in one place. To serve the needs of the people effectively, the major administrative and judicial powers and functions of government are divided and allocated to subdivisions of the country. In the United States, which is a federal union of States, many political powers are constitutionally reserved to the States. None of the States, however, is small enough to have the entire operational mechanism of government

^{2/} Figures in parentheses refer to Literature Cited, p. 68.

concentrated in one spot. Aside from Louisiana, which is divided into parishes, the States are divided into counties and the counties are again subdivided into minor civil divisions.

Boundaries function as dividing lines all the way from property lines up to national boundaries. They divide the continents into independently governed countries and the countries into secondary areas of jurisdiction and authority. But in all instances, only boundaries that are sufficiently well marked and known can properly serve the purpose for which they were established.

An abstract discussion of boundary functions founded on the supposition that boundaries are what they should be - well-defined lines - introduces no conceptual difficulties. Because in itself the term "boundary" is sufficiently descriptive to indicate its function, little has been said by modern authors on boundaries and their functions, although they may touch upon the subject from one angle or another. In this discussion, boundaries are not only germane to the subject; they are one of the principal considerations. Boundaries play an important part in each person's life. Boundaries are needed to delineate the areal extent of estate rights and its obligations; they are essential to the maintenance of peace and cordial relations in community life. No less important are boundaries in the political field. Well-defined boundaries are needed to limit national territories and their civil divisions for effective operation of the judicial, administrative, and service organizations of government.

Less obvious to landowners and tax assessors, but just as real, is how the deterministic functions of boundaries affect the work of statisticians and economists. Any local or regional inventory of ownership or use of land for purposes of study and analysis is usually confined to, or composed of, townships, counties, or groups of counties. In such instances, the total area of civil divisions and subdivisions provide not only a convenient standard of comparison, but all the different land categories, whether they are differentiated on the basis of ownership, quality or use, are presumed to add to a common total. The total land area of political divisions provides, therefore, a check on all other areal figures.

Reliable areal measures of political divisions can be obtained only from surveys of the area. Their factual value depends, therefore, on the identifiability of boundary location in the field, the accuracy of the survey, and the method and control used in measuring the area. Obviously, the land area of a county with uncertain boundaries must be regarded as of uncertain value. Figures of this kind for the total land area of counties, as cited, for instance in the census, are qualified as approximate, but their approximation cannot be stated to be within a definite range.

Boundaries, therefore, have a far-reaching influence on the social well-being of citizens and on the affairs of the State as a whole. Furthermore, boundaries themselves are largely creations of the State. The original titles to the land were issued by the then existing governments, and the civil divisions were organized by or with the approval of the government. On that ground alone, the keeping of proper records of landownership and of the civil divisions of government is, therefore, an administrative obligation of government itself.

Cadaster an Administrative Tool

A depository containing the description of the areas and the limits in which individuals claimed the right to use and own the land became an institution of government in the early stages of civilization. As a tool of administration, this collection of recorded factual evidence concerning landownership has remained a requisite since. The very fact that in all forms of government that recognize the right of the individual to own landed property, the keeping of land records has persisted through the ages is in itself sufficient proof of their essential necessity and value.

Like all the juridical and administrative institutions of government that evolved from rudimentary beginnings, the cadaster, as the depository is now called, had undergone changes in substance and form to keep pace with the needs of an advancing civilization. Records of dimensions and descriptions of individual holdings usually represented the initial phases of record keeping as it was done by the Egyptians and later introduced by the Roman Kings. In the first instance, the records were based mainly on measurements in the field; in the second, they were based mainly on the declaration of individual owners. In the main, all were literal. In the beginning, graphic delimitations were not sufficiently advanced to be of universal application.

The purpose of keeping these records, however, was not confined to the safeguarding of the individual's estate rights, but rather and even more so to the recording of the entailed obligations. All early forms of government were based on an agrarian economy; land was the principal medium of production, as well as the tangible wealth-producing source that could be taxed.

Taxing landed property cannot be accomplished successfully without recognition of the characteristics of the land and the improvements that affect its value. Knowledge of the boundaries provides the information needed in defining the location and size of the area and constitutes the pertinent evidence when landownership is in question, but for purposes of taxation, it is inadequate. Assessment of land on an equitable basis, especially when the land is used for agrarian production, cannot be based on size of property alone. It must take into account the quality of the land or its productive capacity. A number of factors of the physical order that may either raise or lower the productive capacity of the land are involved. Elevation, slope, climate, water supply, and soils are the chief factors in that category. Of these, the soils, which developed under the influences of all the other conditions, come nearest to indicating a localized gradation in land use capability.

In modern times, with most of the products of the land destined for the market, a third element enters into land appraisal on economic grounds. Site advantages have their economic compensations. Accessibility and distance to market are of sufficient consequence to affect the value of the land as a source of production, and usually, they are taken into account.

An equitable appraisal of the land for taxation, evaluation of the land as mortgage security, or determination of its purchase value for agricultural, silvicultural or pastoral use, must probe for facts in more than one direction. As now constituted, land and its use are part of the cultural landscape, which is composed of both cultural and natural features. Usually, the boundaries of landed properties are a succession

of straight lines, which connect one turning or intersecting point with another, except when they coincide with such natural features as watercourses, shorelines, or divides. But the distribution of soils conforms mainly to the distribution of natural features. Consequently, in their arrangement, they represent a complex pattern. In addition to these factors, the transportation and communication system must be considered; it represents the arteries of social life without which no economic development can take place. Accessibility and distance to market are conditioned on its development; they provide a criterion of how effectively the land resources of a country are developed.

To perceive and comprehend the interrelationship of these factors in the spatial order of the landscape and their effect on individual landholdings requires more than a verbal account. All these features must be visualized together on a horizontal plane. This may be accomplished through mapping them on a comparatively large scale, or by using as a base a controlled mosaic made up from aerial photographs. A graphic presentation on the plane and true to scale of these surface features is needed, not only for the comprehension of their spatial relationship, but also for determination of the relevant acreages. In this way, reliable planimetric measures can be obtained to determine the size of the individual holdings, the areas of the different soils within each property, and the land use areas.

The dominant consideration in representing together these fundamental factors that affect the use capability and value of the land is their complementary function. One without the other provides insufficient evidence to permit any definite conclusion. An equitable assessment of land for taxation, and a proper appraisal of its market value depend on both the size of the holding and the quality of the land as indicated by the soil. The location element is taken care of when real properties and soils are mapped as a continuum rather than by individual tracts.

Multiplicity of Cadaster Uses

A review of the utilitarian value of such a procedure discloses that its usefulness extends far beyond the cadastral functions. Now that land use requires continuous adjustment to meet the requirements of an increasing population and an advancing economy, social and individual benefits are directly connected with it. Present and future programs include urban and industrial expansion, development of the communication and transportation systems, flood control, watershed development, crop control and soil conservation, all of which are operations that depend on essentially the same background information in the form of maps. Each of these programs is frequently considered independently of any other. In this compartmental procedure of solving overlapping problems, the door is left open to speculation with its consequent disorderly development of the area.

In recent years, zoning controls have been extended to some of the rural environs to ensure more orderly growth (68). In applying zoning restrictions in such areas, the cadaster surveys necessarily would provide the best foundations for development of the pattern. A more individualized benefit from this type of cadaster survey will accrue to farmers who wish to adjust their field operations to fit the distributional

pattern of the soils. Another, and no less important, application of this type of survey is its value as source material for a statistical inventory and for economic analyses of local and regional land resources and their use.

In this connection, it may be well to point out that reliable figures of some of the most essential and fundamental statistical areal quantities can be obtained only as planimetric measures and not through enumeration. Horizontally controlled planimetric mapping bases also permit controlled areal measures, a relationship that is frequently lost sight of in the use of areal statistics.

As a device to delimit and record individual land ownership, and to classify the quality of the land as indicated by the soil, this type of cadastral survey has a multiplicity of uses. These multiple uses were not all associated with these surveys from the beginning, nor are such surveys everywhere in existence. In fact, the present study was prompted by the absence of cadaster surveys worthy of their name over most of the area of the United States that was settled during the early period. Uncertain locations of boundaries of personal landholdings and conflicting ownership claims, to which must be added the uncertain locations of some State, county, and district boundaries as limits of jurisdiction, are sources of irritation and disputes inherited from that time. Perpetuation of this situation is not only detrimental to the improvement of local conditions; it is even less desirable in the interest of good government. Accommodating the needs of society by improving the operation of government institutions has been a continuous process. To demonstrate the evolution of the cadastral survey in the Old World, the important steps in its development are traced.

HISTORICAL NOTES ON DEVELOPMENT OF THE CADASTRAL REGISTER

TO UNDERSTAND THE PRESENT WE MUST KNOW THE PAST

Early Cadaster Records

An attempt to trace the beginning of the cadaster leads far back into the distant past. To explain the meaning of the name alone takes us back more than 2,000 years in the history of civilization. Cadaster is of Latin origin; it is derived from capitastrum or catastrum, which was the head-tax register of the later Romans. Actually, the register of landed property was introduced in the early Roman period of the Kings. It is attributed to Servius Tullius (578-534 B. C.), the sixth of the seven Kings of Rome. According to the Greek Historian, Dionysius, who lived in Rome during the reign of Emperor Augustus at the beginning of our era, Tullius

... ordered all the Romans to register their names and give in a monetary valuation of their property, at the same time taking the oath required by law that they had given a true valuation in good faith; they were also to set down the names of their fathers, with their own age and the names of their wives and children, and every man was to declare in what tribe of the city or in what district of the country he lived. If any failed to give in their valuation, the penalty he established was that the property should be forfeited and they themselves whipped and sold for slaves. This law continued in force among the Romans for a long time. (16, pt. 15, p. 321)

The introduction of the census in Rome marks the beginning also of the cadastral register of the Romans. The census returns provided the source of the information contained in the register, which in turn was used for purposes of tax assessment and military recruitment. This is about as near as we can come to establishing the beginning of the Roman cadaster from which the government institutions received their international name. In this instance, however, the origin of the name does not coincide with the origin of the institution itself.

Long before Rome was founded, measurements of cultivable land were taken and recorded in Egypt. Since the time of settlement, community life in Egypt, an arid country, has depended upon the waters of the Nile. Before irrigation was introduced, the annual floods of the alluvial bottoms provided the necessary moisture to permit the cultural use of the land. But these floodings of the valley bottoms obliterated field boundaries and made necessary frequent remeasuring of individual fields, a process which in Egypt dates back to approximately 3,000 B. C. The register of size, location, and ownership of landholdings was kept in duplicate; one was deposited in the provincial archives connected with the warehouses where tax payments in kind were received and stored, and the other was kept in the royal treasury.

These measurements and descriptions of the registry were confined to verbal treatment. So far, no plan or map has been discovered to indicate that the land divisions were outlined graphically and recorded in this way at this early stage. Scenes illustrating the operation of land measurement itself, however, are preserved on the walls of Theban Tombs. There are also indications that differences in quality of land were recognized very early, and that irrigation of some of the higher land was resorted to as far back as 2,300 B. C. Provincial boundaries as terminal lines of jurisdiction received particular attention; they were defined by inscribed stone markers, some of which still exist (44, pp. 47-67).

Land Allotment in Canaan

Ancient Egypt is the oldest center of civilization from which evidence is extant to indicate that a register of landed property was instituted at a very early period. That land and its divisions received considerable attention in Egypt may not have been lost sight of by the Jews, who were in residence there for some time. When, after the exodus, the Jews had conquered the larger part of Canaan, the land of Canaan was to be divided among the different tribes. In order to divide the land equitably, Joshua, the successor to Moses and leader of the Israelites, had the land surveyed. We are told that the surveying was done according to the extent and productive capacity of the land.

Josephus, the Jewish historian who lived in the first century A. D., evidently recorded tradition when he wrote the account of the land divisions in Canaan. Several English translations of his works have appeared. One version of the passage describing the land survey reads as follows:

Now Joshua, when he had thus spoken to them, found that the multitude approved of his proposal. So he sent men to measure their country, and sent with them some geometricians who could not fail of knowing the truth, on account of their skill in that art. He also gave them a charge to estimate the measure of that part of the land that was most fruitful, and what was not so good; for such is the nature of the land of Canaan, that one may see large plains, and such as are exceedingly fit to produce fruit, which yet, if they were compared to other parts of the country, might be reckoned exceedingly fruitful, yet if they be compared with the fields about Jericho and to those that belong to Jerusalem, will appear to be of no account at all. And although it so falls out, that the people have but a very little of this sort of land, and that is for the main mountainous also, yet does it not come behind other parts, on account of its exceeding goodness and beauty for which reason Joshua thought the land for the tribes should be divided by estimation of its goodness, rather than the largeness of its measure, it often happening that one acre of some sorts of land was equivalent to a thousand other acres. Now the men that were sent, which were in number ten, travelled all about, and made an estimation of the land, and in the seventh month came to him to the City of Shiloh, where they had set up the tabernacle. (37, par. 21, p. 108).

As described, the division of the land of Canaan is one of the earliest cases known in which the quality and quantity of the land were considered jointly in a settlement program before the land was assigned individually by lot. There are indications also that these two aspects of the land very early received recognition in Mesopotamia and China.

Roman Cadaster Derived From the Census

The introduction of the census and the cadaster to the western world went hand in hand with the expansion of the Roman Empire; Roman institutions were established in the wake of conquest in all the Roman provinces. A census taken on the Tullian principles provided the simplest means of obtaining the desired background information for evaluating a citizen's worth and gave the assessment the appearance of being based on factual information. But the expansion of agriculture into new territory meant also changes in land values, and to discover all the changes required a more elaborate census questionnaire than was used in Tullius' time.

According to an account from Gaul, where the census and the cadaster were introduced during the reign of Augustus, the items called for resemble, in some respects, a modern census schedule pertaining to the agricultural use of the land. Each of these documents was headed with the name of the proprietor of a land unit. At the same time, it indicated the city or canton in which it was located, and, for a closer identification of its location, the names of two adjacent proprietors were cited. In our terminology, the questions in regard to the land itself were: (1) What is the acreage of cultivated land and how much of it was seeded during the last 10 years? (2) What is the size of the vineyard and how many grapevines does it contain? (3) How many acres are in olive orchards and how many trees are in the

orchards? (4) What is the acreage of meadow on which hay was cut during the last 10 years? (5) How many acres were pastured and how many acres of woodland were cleared (28, v. 1, p. 281). As these questions indicate, the element of change received consideration, as in many parts of the Empire agriculture was in its early stages of development. Progress in that direction was recorded through the taking of quinquennial censuses, which also furnished the source material to keep the cadaster up to date.

The Roman cadaster, which was derived from the census, consisted of written documents listing land ownership and land use, without graphic delineation, and in only a few instances was reference made to the quality of the land itself. In these early days, taking a census of an empire as large as the Roman was in itself a tremendous task. It could be accomplished only by restricting the desired information to what could be obtained in answer to elementary questions (75, col. 1518). This restriction to general though pertinent subjects should not be interpreted, however, as conforming to the then prevailing Roman level of knowledge concerning land use and agriculture.

Differences in Land Quality Recognized by Romans

Agriculture, as the chief income- and tax-producing industry, was held in high regard by the Romans. Statesmen and scholars made it a subject of study and recorded in writing their accumulated knowledge to make it available to others. Some of their writings on agriculture, especially those of Columella, Cato and Varro, have come down to us. Even now, they make interesting reading. Of these classical authors, Marco Terentius Varro (116-27 B. C.) probably was the first and most versatile. In his "Rerum rusticarum," he refers repeatedly to the influence of physical factors on land use, which includes soil types and their suitability for various crops. He emphasized this principle when he described what he considered to be the nature of agriculture itself, and said:

In the first place, it is not only an art but an important and noble art. It is as well a science which teaches what crops are to be planted in each kind of soil, and what operations are to be carried on, in order that the land may regularly produce the largest crops (10, p. 185).

Although this definition of agriculture was written 2,000 years ago, time has not dimmed its validity.

Later on, in the first century of our era, Columella, the foremost Roman writer on agriculture, in his second book of "De re rustica," deals even more extensively than did Varro with the land, the soils, and their use adaptability (12). As a student of agriculture, Columella was convinced that a proper knowledge of the land and an adjustment of cultural operations to its natural characteristics were necessary to obtain the best results. But he observed that in practice, frequently little attention was paid to this relationship. The lack of knowledge for the guidance of field operations was so widespread that he deplored the neglect of agriculture as a subject of teaching. Although this may well have been the case, the existence of a differential in the productive capacity of the land was accepted in principle by the government in the assignment of land in their colonies (4, v. 2, pp. 318, 365).

Land Divisions and Records in Roman Colonies

The occupation of conquered territory by the Romans was brought about largely through the establishment of colonies. Of these, the military colonies of the Romans were most numerous, and in more than one respect, they represent a distinct type in the development of the cadaster. The land divisions of these colonies are particularly significant when they are considered in connection with the system of land divisions used in the public domain of the United States. These Roman colonies represent the prototype. In concept, the two systems are the same; both consist of square land divisions laid out on the principle of rectangular coordination. Definite location identification is obtained in both instances by means of symbols indicating the position of a square with reference to the axes of coordination. The differences between the two systems lie in the size and subdivision of the squares and the use of symbols derived from Latin in one instance and from English in the other, in conformity with the custom of the period and the country in which they were and are used.

The Roman military colonies were divided uniformly into *centuriae*, or squares containing 200 *jugera*. A *jugerum*, the standard field measure of the Romans, represented a rectangle 120 x 240 feet in size; it was only half a square containing 28,800 square feet. As an areal measure, the length and width of the *jugerum* are an adjustment to the labor efficiency of that time, that is, a *jugerum* represented a tract of land a man could plow in one day. The Roman and English feet, though not exactly the same, differ so little that for a general comparison no conversion is needed. The traditional *heredium* of two *jugera* assigned to the early Romans was therefore approximately 1-1/3 acres. The measure of land allotted to settlers in the military colonies was larger and not uniform. The allotment differed with the rank of the veteran and the quality of the land. In the few instances cited by Titus Livius in his notes on the colonies founded between 193 and 181 B. C., the number of *jugera* allotted to soldiers on foot ranged from 15 to 50; mounted officers usually received twice that number. In citizens' colonies of the same period, the number of *jugera* assigned to individual settlers ranged from 5 to 10 *jugera* (43).

Another aspect of the colonial cadaster is not shared by the cadaster derived from the census. This is a cadaster plan. The identification of land divisions in a colony did not depend solely on verbal description. The divisions were delineated graphically and presented in a coordinated plan of the entire colony. After the divisions of the land were laid out and fixed with markers in the ground, the *gromatici*, or surveyors, executed a plan of the colony in duplicate. One, called "*mappa*," was drawn on linen and sent to the archive in Rome. The other, called "*forma*," was engraved on copperplate but remained on exhibition in the colony. Any disputes arising among the settlers about property boundaries were settled by referring to the *forma* (42, p. 30). In a number of places in Italy, especially in the Po Valley near Padua, Imola, Cesena and others, the colonial division of the land into squares is still in evidence today. In these places, the present road and settlement patterns are founded on the old Roman land divisions, which were laid out more than 2,000 years ago (15, pp. 324-325).

The Domesday Inquest in England and the Down Survey in Ireland

In more than one respect, the Romans made significant contributions to the development of the cadaster. This trend was interrupted by the downfall of the Roman Empire in the fifth century. Little or no progress was made during the Middle Ages, although the need for reliable information on land and people, to give purpose and direction to the affairs of government must have been as much felt as in Roman times. England was first to make an effort to fill the gap. It was in the winter of 1085 at Gloucester, that William the Conqueror made his "deep speech," in which he ordered for the following year the domesday inquest (48). In concept and execution, his inquest, however, was nothing more than a revival of the old Roman institution of census taking. The results were collected in two volumes, which are known as the "Domesday Book." The names of the principal landowners, the extent of their holdings, the value of the land and livestock, the number of servants kept and so on, were recorded in it, for purposes of assessment.

No actual land survey of national significance was undertaken in England until six centuries later. This survey was planned in England for application in Ireland, in 1654-58; it is frequently referred to as "The Down Survey" (62). Its name is derived from the frequent repetition in the report of such expressions, as "laid down by admeasurement" and "by the survey laid down." The survey was concerned primarily with the division of the confiscated land in Ireland after the conquest. Land tracts and parcels were needed that could be assigned, by means of a lottery, to the adventurers and soldiers who had supported or fought for Cromwell, and to whom payments were in arrears. It was, therefore, first of all an instrument designed to help in the allocation of the spoils of war.

In surveying the confiscated properties, their areal measures and the quality of the land were to be established, as well as their location with reference to other properties. To facilitate the presentation of the confiscated properties in their relative position and extent on the map, the survey employed the principles of rectangular coordination known from the Romans. Baronies, or counties, were divided into quarters by running two rectangular intersecting main lines or axes of coordination, usually in the north-south and east-west directions. The quarters were again subdivided into squares, which served as control for the location of the confiscated properties in the field. The maps were drawn on the scale of 40 perches to the inch, or 1:7920. To determine the acreage of the confiscated properties, these squares were again cross-sectioned on the map by a screen of smaller squares representing definite acreages. By counting the full squares within the area of the tracts and estimating the fractional proportions included along the boundaries, the areas of the tracts were obtained. The quality of the land had to be inferred from its use, which was denoted either arable, pasture, meadow, timberwood, shrubby wood, or bog. In the tabulated returns from the survey, these distinctions were condensed into profitable and unprofitable.

As a survey of land ownership, the Down Survey was not conceived with cadastral use as the ultimate objective in mind, although it contains some of the functional requisites of a cadaster. It was one of the early devices to map the boundaries of diverse land holdings and determine their acreage.

The First Cadaster Surveys Made by Sweden

In continental Europe, conditions remained uncertain for some time after the Middle Ages and no effort was made to obtain more factual information as to who owned what land or how it was used. Apparently, Sweden was the first country that tried to obtain more reliable information on landownership than was presently available. Orders to land surveyors dated as far back as 1585 are extant. Sweden had started in the middle of the 16th century to explore and map the country. Latitudes were obtained from polaris observation, and triangulation was used to determine the relative position of control points for the survey.

In the execution of their work, the surveyors were not only to identify and record the existing ownership divisions; they were instructed to observe the prevailing man-land relationship in the different localities. When maladjustment was evident, they were to rectify it. To permit them to do this, the land surveyors were vested with considerable discretionary power to adjust land ownership. When, for instance, they found that a village had more land suitable for agricultural production than it used, additional homesteads were to be laid out. Similarly, when a surveyor encountered large farms that had considerably more potentially arable land than was cultivated, he could divide it into two homesteads. The value of the land survey as the foundation of the land register soon became apparent, and, in 1628, the land surveyors were given civil service status by the government.

At that time, Sweden's domain was not confined to the Scandinavian Peninsula. During the Thirty Years' War, Sweden had also acquired provinces across the Baltic. One of them was western Pomerania, which stretched as a belt along the southern shore on the Baltic from the Oder to Stralsund, with the Isle of Rügen included. Like the homeland before the survey, this province had no reliable register for tax assessment, and, with the experience gained at home, in 1691, a land survey for Swedish Pomerania was ordered; in 1692, it was implemented with instructions (18). In concept and scope, as the instructions indicate, this survey plan was far ahead of anything in the way of land surveys attempted up to that time.

The order to survey the land of Swedish Pomerania encountered a number of obstacles. The higher ranks of the landowners, fearing higher taxes, strongly opposed it. The particular linear measure to be used as standard in the survey was also a point of debate that delayed the start, as several values for the same measure were in current use. All these obstacles were finally surmounted, however, and the survey was executed according to instructions. The instructions envisioned more than a cadaster survey. In reality, it was in the nature of an economic inventory.

As the mapping scale of the province was large enough, 1:8000, many of the natural and cultural features could be included. The roads in towns, villages and open country, with their isolated houses and farmsteads, were represented, as were the courses of natural and artificial drainage channels. Within this framework, the boundaries of individual landholdings, as well as those of State and community lands, were located and delimited, along with the boundaries of districts and communities. Conflicting boundary claims were indicated. Land use categories, whether cropland, hay meadow, pasture, swamp, stony or sandy wasteland, heath, brushland, woodland or forest, were distinguished. Also noted were the texture and productive

quality of the soil, the carrying capacity of the pasture, and the composition and stand of the woodland and forest. Notice was taken also of mines, quarries, saw-mills, windmills, saltworks, brickyards, wharves, fishing grounds, and so on with their outputs and turnover. Points of more general interest, such as monuments, churches, castles, forts, ruins, and battlefields, were to be recorded also.

The fieldwork of the survey itself was executed on plane tables, with the relative position of points fixed through graphic triangulation wherever visibility permitted. When this method was not feasible, chaining and compass traverse lines were resorted to. After the fieldwork was completed, the maps provided a plan replica reduced in scale of the features observed in the field. With the outline and shape of areas represented true to scale and form, the maps provided the model from which the areal measures were obtained.

The survey started in 1692 and was completed in 1702. Seemingly not all the maps can be accounted for; as reported, 965 maps on the scale of 1:8000 were required to cover the area of Swedish Pomerania and Rügen exclusive of the districts of Usedom and Wallin. Areal computations were not confined to landed property; they were extended to include land classes and land use distinctions. Land classes, which were used for tax-assessment purposes, were established by applying yields to soil classes. These detailed records also furnished the source material for statistical compilations to apprehend the land resources of communities as a whole. All these areal computations, and the descriptive texts of the properties derived from field observations formed the contents of the cadastral register of the province, which comprised 39 heavy tomes. To preserve the relationship between maps and register, the register was indexed by means of numerical and letter symbols corresponding to those used on the maps. Supposedly, the other Swedish provinces of that time, which were located on the southeastern shore of the Baltic were surveyed in a similar way, but western Pomerania appears to be the only province for which a historical study was made.

It must be evident from these notes that at least in concept the cadastral survey of Swedish Pomerania approached closely to what we now consider the requisite for a proper value appraisal of landed property. Compared with modern technical standards of surveying and soil classification, the Pomerania survey and its graphic products, the maps, conform necessarily to the standards, or rather the lack of standards, prevailing at the time. Nevertheless, this survey marked a mighty step of progress in that it used the proper approach toward obtaining a factual background for the evaluation of landed property and the determination of equitable estate taxes.

Cadastral Surveys in the Dukedom of Milan

Meanwhile, the extent of land holdings and equitable taxation became a more pressing problem in other European countries. The old form of census-taking instituted by the Romans was largely neglected, although it was used occasionally to obtain some foundation for assessment purposes. Tax problems existed in all the countries of western Europe, but they created more unrest and disorder in some countries than in others. Little documentary evidence is extant to show how fiscal transactions were conducted at that time. But one account has come down to us that

permits an insight into the situation and records the steps taken to resolve the difficulties in the fiscal administration of the land. This is an account of the work and procedures of the Census Committee in the dukedom of Milan, which was issued and reissued in printed form (19).

For two centuries before the Census Committee received, in 1718, its commission to take a new census of the dukedom of Milano, nothing had been done to secure a more equitable tax distribution. Amounts of revenue were allotted by the comptroller of the Treasury to communities, and the communities assigned amounts to individuals. Salt, horses, and merchandise were taxed also, but most of the revenue was obtained from immobile property. Assessment of landowners, however, was haphazard. For many of the properties, not even the size of the holding was known. In this respect, the situation was somewhat akin to the one found in eastern United States. Parts of the dukedom were divided into rectangular tracts, and the remaining parts were not surveyed. The rectangular tracts can be identified with the areas laid out by the Romans for colonial settlement, which are in evidence today. For these tracts only was the size of holdings known. Under these circumstances, arbitrary decisions and adjustments were inherent in the tax-assessment procedure; they produced incongruous results. These results led to discord and unrest among the population.

Other vexing problems that affected the economic and social conditions of the population had developed also. Some of the old concepts of taxation inherited from the Romans had become obsolete under the new regime. Under the Roman system, taxes were considered a strictly personal obligation that had to be discharged wherever the person resided. However, landowners frequently lived in towns, where they paid their taxes. In this way, the rural districts were drained of their fiscal revenues. This problem was further complicated by the uncertain status of many smaller communities and by the indefinite boundaries that separated the rural from the urban districts. All of these problems received the attention of the committee, but obviously they could not be solved by the simple device of enumeration.

Fully aware of the situation, the Census Committee proposed, in 1718, to have the landownership for each community determined through a survey. The proposal was accepted, and the survey was ordered for the following year.

In conformity with the plan, communities and their boundaries had to be determined. In the process, the smaller communities were recombined with the parent communities from which they had been separated. The community in turn provided the working unit in which the landlines were surveyed and represented on the landownership map. In agreement with this map, a register of the landowners with their assessment was prepared and called "catastro." Assessment was based on the estimated value of the property as indicated by the productive use made of the land — vineyard, ricefield, meadow, pasture, cultivated land, mulberry grove, or woodland. Moreover, as a rule, absentee landowners found that their lands were assessed in the community in which the lands were located.

The survey and register neared completion in 1733. Most of the communities had received their community map and register, and the work was commended by the government. During the same year, the dukedom was invaded; this ended for the

time being the activities of the census committee. Nothing was done during the next 16 years, but after peace was restored in 1749, the sovereign reappointed the census committee to finish the census. During the turbulent years, many of the maps and records, which had been transferred to the communities, had disappeared and had to be replaced with new ones. Changes in boundaries and watercourses had occurred also during the preceding 30 years. To bring the maps and register up to date, these changes had to be incorporated.

The Census of 1750 departed from the usual enumeration method. The inadequacy of the old census taking was recognized. It had proved to be disappointing or even a failure, as not all the land was reported, nor were the reported properties properly described for boundary identification. In the latter instance, the answer to the question of who owns what land was derived from a survey in the field and recorded true to scale on the map. In this way, a problem of long standing was resolved. Chaos had given way to order. All of this was fully reported in the activities account of the census committee. The merits of the printed report were sufficiently impressive to obtain for it a wide distribution, so much so in fact that a second edition was issued. The indications, therefore, are that its beneficial influence was not confined to the homeland. Evidently, it extended to neighboring countries, where similar procedures were soon initiated. It has been stated also that this report provided much of the fundamental information and reasoning on which the modern Italian cadaster, approved in 1886 and now completed, is based (22).

Cadastral Surveys in France, Germany, and Austria

Land surveys did not always start as a government function; frequently, they were carried out by private surveyors. Although this procedure helped to improve the surveying technique and instruments, it produced neither uniformity of scale nor standard treatment of the contents of the maps. Nor did it produce continuity of the area mapped. Some communities or well-to-do estate owners could engage surveyors to do their mapping, but this did not solve the national problem. To do this, the governments themselves had to organize the surveys.

Following the revolution, the French assembly passed, in 1791, an act to establish a cadaster based on a land survey. In 1827, the provisions of this act were revised to define the operation and procedure of the survey. The stipulation was that the survey must be based on triangulation, with the boundary of each community, as well as that of each parcel of land, its ownership and its cultural use, determined. These property maps or "parcellaires" were drawn mainly on a scale of 1:2500. To show the relative position of these plans within the community, on an index map prepared on a scale of 1:10000 the individual sectional plans were outlined. None of these maps was published. All were used in manuscript form (74, p. 7).

France was the leading exponent of the cadaster surveys at that time. From there, they spread to other countries. At the beginning of the 19th century, Napoleon introduced the cadaster, based on land surveys, into the Rhineland and Westfalia of Germany. This system was later expanded to include all the other provinces, and, in 1877, it became the national ownership register. All of these cadaster surveys were concerned mainly with determining and recording ownership boundaries,

administrative boundaries, and the acreage involved with its economic use. Cultural features and drainage courses provided the background for spatial correlation. As yet, land quality was referred to in general terms only. Increase in population and a more intensive use of the land for agricultural and silvicultural production also increased the value of the land and made necessary a more equitable appraisal founded on the physical quality of the land.

A new farm appraisal procedure was developed. It took into account the lay of the land, soils, climate and drainage, as well as advantages and shortcomings of location (66). Planning the economic development of the country as a whole within the framework of the physical potentiality required a similar background of facts. These facts could be of value only when presented in spatial coordination with other features on large-scale maps. To provide for these needs and to implement the Farm Appraisal Board's procedure, the law enacted in 1934 provided that the soil survey in relation to land ownership be extended over the whole country. Hanover was the first province surveyed in this way (7). World War II interrupted the work, but in all occupied zones the survey was taken up again. It is now completed or nearing completion (65, p. 6).

In Austria and its former crownlands, a cadaster survey was ordered in 1825. Although no descriptive work for the whole empire is at hand, some condensed notes on parts of it indicate what was done. One of these parts was what used to be the Kingdoms of Lombardy and Venetia in northern Italy. At the congress of Vienna in 1815, these kingdoms were attached to Austria and consequently were included in the cadaster survey ordered by Emperor Francis I. The survey of the two kingdoms, which was approved by law in 1845, took 28 years for completion (42, p. 58).

Shortly after the cadaster survey of these two provinces was completed, they were transferred, in 1859 and 1866, to Italy, but the Austrian cadaster was again legally approved in 1869. It remained in force until resurveys displaced the old ones. Improvements were introduced, however, in 1883. The old cadaster survey was mainly "probatorio," that is, it contained the evidence of land ownership without providing sufficient information to permit a proper evaluation for taxation, or in other words, to make the cadaster "tributario." The scale of these old cadaster surveys is 1:2880, but in resurveys the scale of 1:2500 is used, except for areas of dense settlement or strongly fractionalized landownership. In such instances, the maps are drawn on a 1:1250 or even a 1:625 scale.

As organized by the Austrians, the cadaster consists of a number of documents. The cadastral map of the community, the documents of ownership, the descriptive records of each parcel or tract of land, and an alphabetical and numerical indexed list of landowners in the community with reference to this map, are all parts of the cadaster. All of these references to the land are tied in and correlated with the contents of the ground-book or deed records, in which the origin of the title, transmission, and division of rights to the land are recorded. Although these deed records are not considered a part of the cadaster itself, they must be always in full agreement with the cadaster. In the case of boundary disputes, no changes can be made in either before a legal decision has been reached. This decision depends on the findings of an investigation on the ground. A magistrate, a councilor, two selectmen, a surveyor, and the head of the community, in addition to the parties concerned, must be present to argue and decide the case (8, p. 3).

English Land Surveys

The early efforts in England to obtain related information on land and people were mentioned earlier in this report. Evidently, no satisfactory answers could be obtained to inquiries among landowners about their holdings if the land had not been surveyed. It is an old axiom that factual evidence on the shape and acreage of parcels and tracts of land is conditioned on the strict application of geometric principles, a requirement that cannot be bypassed successfully with the use of make-shift procedures. That actual surveys were essential was sufficiently evident. Private surveyors, although quite active, could not cope with a problem of national proportion. A systematic survey of land ownership, which is fundamental to the imposition of taxes, started as a function of government and no doubt will remain so in the future.

As a government institution of England, surveying was at first military in scope and organization; it was designed to produce a map of the country on the scale of 1 inch to the mile. Surveying began in southern England in 1795. It was preceded by triangulation, which not only established control points in England but connected the English triangulation net with those across the channel in France. After some of the sectional maps had been issued, the land-acquisition policy in Ireland and an inequitable tax structure introduced the problem of determination of landownership and of valuation of land into the mapping program. As it happened, the urgency of the work in Ireland received priority over the survey in England. Work on the county surveys of Ireland, on the scale of 6 inches to the mile, or 1:10560, was begun by the Ordnance Survey in 1825, and the maps were completed in 1845. These county maps contained among the planimetric features the outlines of the land parcels, but in the end, they were found still to be on too small a scale to accommodate all the administrative requirements they were intended to serve.

Aside from these shortcomings, the many advantages of these large-scale maps as tools of the civil branches of government in the administration of legal and fiscal affairs were nevertheless sufficiently impressive to make a revision of the whole mapping program desirable. The outcome of these deliberations was the discontinuation of the 1-inch-to-the-mile survey, which was replaced by large-scale mapping to accommodate the civil needs. A shift in emphasis of the mapping purpose away from military and toward civil needs brought about the change in the survey scale. To accommodate these needs, it was decided to survey almost the whole country on the scale of 1:2500, or 25.344 inches to the mile. Only the urban centers were surveyed on a larger scale. Moors and mountains were surveyed on a smaller scale. Eventually, even Ireland was resurveyed on the 1:2500 scale.

This reorientation of the English survey program according to benefit accrue-ments had its reaction on the status of the survey itself. The Ordnance Survey began its functions as a military organization, but with increasing recognition of its fundamental value in the civil branches of the government, and after an intermediate shift, the survey was transferred to the Ministry of Agriculture and Fisheries, where it remains.

With the contents of the "National Plans," as these large-scale maps are referred to in England, controlled in position by a national system of triangulation,

the adjoining sheets can be readily combined and used as source material for the smaller scale maps. Actually, all the smaller scale maps, of which there is a standard series, are based on these plans. The next step down on the scale of the map series is the 6-inch-to-the-mile, or 1:10560 scale, map, on which some of the features of the larger scale maps are omitted but contoured relief is added. As conceived and executed, the 1:2500 scale plans function as cadaster surveys. In addition to the other cultural and drainage features, they contain in outline the parcels or tracts of land owned by different parties, which in the rural areas are numbered in conformity with the land register. In addition, the acreage of each of these parcels is printed on these maps down to the nearest thousandth of an acre (31, 74).

As organized in England, the cadaster, if it may be called that, as yet fulfills modern requirements only in part. The map and the register contain the evidence of location, size, and ownership of the land. The register may also say something about land use for the purpose of evaluating the property for taxation. But so far, land use capability for agricultural production, as indicated by the soil, has not been included, although a soil survey is now in progress. A consistent recording of land use on maps is also relatively recent. It is the result of a mapping project carried out mainly by volunteer workers between 1930 and 1947. The purpose of the project was primarily a geographic one, but these maps can also be consulted with profit when land appraisals are made. As a recording base in the field, the 6-inch-to-the-mile maps were used, but the use distinctions obtained in the survey were printed and issued on the 1-inch-to-the-mile maps (69). From whatever angle these land-use surveys are considered, they are an outstanding civic achievement, which would not have been possible without the detailed large-scale maps as a working base.

The Cadaster on the Agenda of the First International Statistical Congress, 1853

An equitable adjustment of the obligations of the land-owning citizenry to their government, however, was only one of the problems with which the countries were confronted. With the increase in population and the progressive industrialization of the countries, the need for clarification of administrative and social problems became apparent also. Dealing with questions of this kind, however, required numerical expression to permit analytical studies, and to obtain comparable norms and treatment of statistics. Therefore, the International Statistical Congress was organized; it had its first meeting at Brussels in 1853. Cadaster surveys were included in the agenda of this meeting because these surveys could produce factual information in regard to areal measures pertaining to landownership and the cultural use of the land.

An appointed committee had studied the various cadaster questions. Its report was presented to the assembly by M. Davila, delegate of Portugal. The report contained recommendations basic to the execution and maintenance of the cadaster. After their reading, they were submitted to a vote and approved by the assembly. These recommendations were in regard to triangulation control, scale of maps, boundaries of landownership, communities and districts, acreage determination, records of ownership and cultural use of the land, organization and maintenance of the cadaster, and so on. Freely translated, the concluding remarks of the committee report summing up the situation are as follows:

We finally propose that the cadaster is made in such a way, that in time and by following the recommended rules, it will contain the proofs of title to a property, yet we do not wish the cadaster to be a purely fiscal instrument; we do wish its mission to be more elevated; we wish the cadaster to be an inventory of the landed property of a country, the great book where every proprietor can find the title to his property; we wish the cadaster to be the foundation of statistics pertaining to the land, of the statistics of agriculture, of the mortgage system, of farm credit, in short, to be the source that contains the answers to all questions concerning real property. Considered from this point of view, we feel that the organization of a cadaster is one of the greatest benefits that can be bestowed upon a country. (13, pp. 134-138)

The recommendations of the cadaster committee were approved not only by the Statistical Congress; they were received with approval in the countries represented. In England, the Statistical Society of London approved the recommended 1:2500 scale for cadastral maps, which is also the scale used in France. As a consequence, the first survey, that for County Durham, was ordered on this scale, so that the beginning of the land survey in England on the 1:2500 scale actually dates from 1853 (31, p. 33).

These historical notes on the cadaster development in the larger countries of central Europe do not pretend to be exhaustive nor are they intended to create the impression that cadaster development was confined to these countries. Cadasters have been organized also in countries outside Europe (3). Some forms of register of real property have been in use since antiquity. In itself, this is a convincing testimonial to their necessity. But it is only in modern times that the technique of surveying has been perfected to the extent of providing precise horizontal control to obtain the needed accuracy, and to obtain equally reliable areal measures from maps. In this respect, the European cadasters furnish examples of the precision expected. However, precision alone is not sufficient to give the cadaster those functional qualities needed for the increasingly diverse services it is expected to supply. Changes and additions in contents required represent the more recent phase in their development, a phase that requires further consideration.

LAND ACQUISITION BY SETTLERS IN THE AMERICAN COLONIES

Any discussion of the acquisition of land titles by European settlers in the American colonies cannot ignore entirely the rights of the Indians to the land they had inhabited for centuries. The Indians did not recognize individual landownership; they held the land in common. No specific mention of Indian rights to the land was made in the charters to extensive tracts of land in the New World for colonizing purposes, which were issued by European monarchs to Court favorites and trading companies. In the colonies themselves, the question was treated in different ways. In the Mid- and North-Atlantic colonies, Indian rights to the land usually were acknowledged. These rights were either acquired through treaty and purchase from the Indians by the proprietary governors or through purchase from the Indians by the settlers themselves. This procedure was not always strictly adhered to by the settlers, nor in all instances were the boundaries of the ceded land sufficiently well

known or established to prevent transgressions. In the Spanish colonies to the south, the law of the Indies, which did not recognize Indian rights to the land, was applied.

In the American colonies, the mode of acquiring title to the land from established government authorities and the type of settlement were far from uniform. In some parts, especially in New England, the settlement pattern was the community type, while in other colonies, aside from the cities that grew up on favorable harbor sites near the coast or at the head of navigation on the larger rivers, settlement was largely the openly scattered homestead type, in which cultural and administrative centers developed after the country was settled. The procedure of acquiring title to the land necessarily differed with the type of settlement and in some colonies also with the time of settlement.

The task of tracing the relationship between the type of settlement and the way in which the settlers obtained title to the land in the different sections of the colonies was beyond the scope of the study. Much has been written on the subject (11, 34), but only a historical sketch of the settlement period is presented here to show the cause and effect relationship of present conditions with the past.

European settlement on the mainland of North America started at the turn of the 16th century. At that time, feudal landownership was still the order in Europe, although serfdom itself was no longer recognized in some countries or was being abolished in others. Phases of this type of landownership were transplanted to the New World by granting or selling large tracts of land to settlers, which were known in the South as plantations and in the Middle Atlantic colonies as manors. Serfdom had its modified counterpart in the form of indentured servants who were contracted to the large estate owners, for whom they were obliged to work a stipulated number of years to gain their freedom.

Virginia

The first English settlement on the South Atlantic Seaboard that was successful was made by the London Company in 1607 on the James River in Virginia and called Jamestown. The London Company was organized, in 1606, under the patronage of James I, King of England, who granted it the first charter of Virginia. According to this charter, land was granted to the company for settlement at any place on the coast of Virginia between the 34° latitude and 41° N. A second charter granted in 1609 reduced the Territory of Virginia latitudinally by defining the boundaries as being located 200 miles north and 200 miles south of Point Comfort, but extending them westward to the South Seas. By so doing, the claims of the London Company were separated from those of the Plymouth Company, both of which had been organized and received their initial charter at the same time. A third modification of the Virginia Charter was issued by the King of England in 1612. In the new charter, all the islands located in the Atlantic between latitude 30° and 41° N. (approximately between St. Augustine, Fla., and Long Island Sound) and within 300 leagues from the American Coast, were transferred to the Virginia Territory.

The financial structure of the London Company rested on the lands of the colony which furnished the countervalue of the stock. Land was to be surveyed and assigned

by lot to the shareholders at the rate of 50 acres per share. Later when the treasury of the company was exhausted, the rate per share was raised to 100 acres. Some of the owners occupied land thus acquired, but frequently it was occupied and developed by tenants. In addition, large land grants were made to associations for group settlement; they were usually called plantations or hundreds. The London Company also introduced the "Head Right" concept into their land-disposal operations by means of which the head of a family, including servants and persons for which transportation to the colony had been paid, could claim 50 acres per head. Persons who had performed a meritorious service to the colony were rewarded with grants of land, and some of these grants comprised a considerable acreage.

Financial difficulties and internal dissensions, however, hampered the effective functioning of the London Company to the extent that its exercise of authority came to an end in 1624. But even before the London Company was dissolved, the authority to grant titles to land in Virginia had been extended to the governor, and land grants were made by the governor and council rather freely. According to a compilation made by Bruce (6, v. 1, pp. 528-532), the grants were at first of moderate size, but both the average and the maximum acreages increased considerably toward the end of the century; some grants comprised up to 20,000 acres. Head rights, however, had ceased to be recognized.

With the dissolution of the London Company, its second and third charter territories were claimed by its successor, the Virginia Colony. But frequently the purport of events that followed was not adjusted to these prior royal commitments. By the time Virginia joined the Union, its original territory had been considerably reduced. Most of the separations came about when additional colonies were established through new royal charter grants to courtiers. The section north of the Potomac and the northern end of the Delaware Peninsula were granted, in 1632, to the Calverts, who founded Maryland. In 1681, Charles II gave a charter grant, comprising the Pennsylvania Territory, to William Penn, and the next year, the Duke of York conveyed to him, in two deeds of feoffment, the tract of land that is now Delaware. In the southern part of Virginia, charters were granted, in 1663 and 1665, to the Carolinaproprietors. Finally, the westward extension of the Virginia Territory to the South Seas was eliminated in the French Treaty of 1763, which gave the country west of the Mississippi to France.

Only in exceptional cases did the boundaries of the new grants follow natural lines; usually, their locations were uncertain and overlapped older grants, thus causing boundary disputes among the proprietary governors. Boundary disputes on the administrative level had their inception, therefore, with the royal grants, and as the method of acquiring title to the land by the settlers was frequently even less formal and definite, boundary disputes soon spread to the occupants of the land.

Land speculation, which had become noticeable in the first century of colonial development, gained momentum at the beginning of the 18th century. Land grants made ran into hundreds of thousands of acres. English lords coming to Virginia were empowered by orders of the King to grant land in certain sections of the country in which the governor granted land at the same time. Shortly before the Declaration of Independence was signed, squatters received from the Virginia Council the right to preempt up to 400 acres of the land on which they had settled. If the land was held as a soldier's claim, it was free. Otherwise, the settlers were to pay £3 per 100 acres.

Land acquisition by the settlers in the Virginia Colony was neither systematized nor did it follow any particular principle or order of division. In its initial stage, while settlement was confined to the banks of the tidewaters and the larger streams, site descriptions and acreages were derived from measurements along the water's edge and from lines run back from its banks. But even these simple operations were not always executed properly nor were the boundaries sufficiently well marked for identification. Inland, the settlers or speculators were free to locate warrants on any unappropriated land within extensive areas. Location advantages, which usually pertained to water supply and quality of the land, determined their choice.

When the existing difficulties in surveying such tracts are considered, the results cannot be expected to conform to present standards. Running of boundary lines in wild and heavily wooded country, with the simplest instruments and frequently by unskilled operators, did not make for precision. Boundaries were poorly marked and could not be identified. Frequently, contiguous grants were not recognized and overlapping of grants resulted. Cases in which a settler developed a part of his neighbor's property, although it was within the limits of his grant, were not uncommon. In order to clear up such cases, special laws were enacted by the Council to define the conditions under which such disputes could be submitted for settlement (6, v. 1, pp. 540-543).

New England

In New England, in which colonial settlement started almost as early as in Virginia, the acquisition of land for settlement was at first an even more perplexing venture. Both England and France claimed the right of colonizing certain areas. In the end, however, England gained the ascendancy in the dispute.

As for Virginia, a company – the Plymouth Company – had been organized in England in 1606 to settle the country. Actually the two companies had received their charters together, without properly separating their respective territories of authority. In extent, the first charter of the London Company was overlapping with that of the Plymouth Company, the territory of which extended to latitude 45° N. As there was no distinct dividing line between the territories of the two companies, the London Company granted land to the Pilgrims as far north as Delaware, but these lands were never occupied by them. In a number of cases in New England, land was granted without definite boundaries. Of the settlements begun, some succeeded and others were abandoned. Taken on the whole, the operations of this company did not prove to be an unqualified success, so that, in 1620, the company was reorganized as the Council of New England. Under this name, the company operated at first from headquarters in England, but, in 1629, its seat of management was transferred to Massachusetts. The territory assigned to the Council of New England for its operations was, as the name implies, more restricted than the one granted to the old company.

As it developed, the management of the council was not successful. Grievances among the colonists increased and were finally heard in London. As a result, in 1635, the House of Commons declared the charter forfeited. Becoming aware of the proceedings, the council deeded to its eight members all the unappropriated land up to 60 miles from shore, and then surrendered the vacant charter.

But New England was not to be developed as a unit. Royal grants of its partly settled sections were issued to persons or colonies endowed with the powers of government. The Massachusetts Bay Company had received its charter in 1628, and, 2 years later, it established management headquarters at Massachusetts Bay. The Colony of Connecticut received its royal charter in 1662. Grants of the Territory on Narragansett Bay, or what is now Rhode Island, were made in 1663 to the towns on the shore of the bay. New Hampshire, which included what is now Vermont, received its recognition as a province in 1680, reverted for a short time to Massachusetts, but was reestablished as a separate province in 1692. Grants were made also in Maine but were later acquired by Massachusetts.

The early land grants by the crown to persons or associations usually were of considerable size, with a general indication of location but with no definite boundaries. Frequently, settlers located and developed their sites without having title to the land. This was done by the Pilgrims and by other communities located on Massachusetts Bay; title to the land was acquired later. The land titles issued by the Massachusetts Company were chiefly for small or medium-sized tracts. Settlements usually developed in the form of closed communities or towns, in which some of the land was held and used in common. From this type of settlement eventually evolved the prevailing settlement pattern of New England.

With the expansion of settlement it became advisable to regulate the procedure of assigning land. As early as 1634, a committee was appointed to set out the boundaries of unsurveyed towns or boundaries in dispute. In 1641, each town that had received a grant was ordered to set out and mark properly the boundary of the grant within a year's time. No strictly uniform rules evolved as to the size of the grant or the number of proprietors required to receive a grant of land in common for establishment of a new plantation or town. In time, however, the procedures in all the New England colonies became similar.

The commoners, as the proprietors of a township grant were called, had to receive leave from the court to start a new town settlement on a selected site, which usually was contiguous to others already granted. The size of these community grants for town settlement varied. For the earlier towns, the land grants were rather small, but in time they increased up to 8 or 10 square miles. With experience gained, it was found that 6 square miles was about as much land as such a community could handle conveniently. Accordingly, 6 square miles, or its approximate equivalent acreage, became the prevalent size of the New England township.

The division of the land in the township itself and the transfer of titles to individual settlers were not on equal terms. The commoners usually allotted land among themselves according to an individual's worth, and the noncommoners received very little. Unallotted land was held and used in common, with the outlying parts reserved for later division. Under this system of land division, allotments were confined to the relatively restricted area with which the townspeople were well acquainted. Furthermore, the allotments were contiguous and the boundaries were known, so that, as a rule, little confusion resulted from that source. Greater attention was paid to township boundaries to guard against uncertainties. In Massachusetts, towns were ordered to have their bounds perambulated once in 3 years; in Connecticut each year (20). In some parts of New England, township boundaries are still perambulated at regular intervals.

As organized during colonial days, townships have largely retained their governmental functions. In this respect, the township government of New England is peculiar to this region. It is found in no other part of the United States.

New Netherland (New York)

After Hudson, an English captain in the employment of the Dutch East India Company, had explored, in 1609, the river named for him, Holland claimed the Hudson Valley as its territory of operation by right of discovery. At first, its main objective was trading with the Indians, but this was soon expanded to include settlement and colonial development.

With this objective as a goal, Holland granted, in 1621, a charter to the newly organized Dutch West India Company with the exclusive privilege of trading and making settlements in New Netherland. The government of New Netherland was to be organized in keeping with the prevailing feudal custom of the homeland. From the start, the settlements on the Hudson were patterned on that model. The "Patroons," who were usually connected with the Dutch West India Company, obtained title to the lands they were to settle and develop. Settlement on these estates was of the village community type, associated with the manorial system. On the farms laid out, houses and barns, cattle, and implements were provided by the patrons. As the lord of the manor, the patron assumed the prerogatives of a medieval lord; his land was held in feudal tenure; he held court and imposed restraints on the activities of the settlers. In short, he held the reins of the local government. With the permission of the director and council of the province, other settlers could locate outside these manorial estates, and acquire as much land as they were able to improve. In such instances, no manorial privileges were conferred on the owners of the land.

Under these regulations, settlement of New Netherland, as the province was called, was slow; the restrictions imposed by the patrons were too irksome to be accepted by the settlers. To attract more settlers, the monopoly of the Dutch West India Company was abolished, and a less restrictive charter was granted in 1640. Under this more liberalized policy, the head of a family of five members each more than 15 years of age could settle and claim 200 acres of unappropriated land. In addition, representative government of the communities was gradually recognized, but community growth was haphazard. In New Amsterdam, it was so bad that, in order to eliminate some of the nuisances, "fence viewers" were appointed. In addition, they were to approve each new building that was to be erected. Viewing fences was not a peculiarity of New Amsterdam; in other Dutch communities, it was applied to field fences.

Under the new provisions, settlement gained momentum; more immigrants arrived from Europe, and settlers from New England came in quest of greater freedom. But settlement was still at random; it had no preconceived order. To dispel any apprehension of prospective settlers on that ground, in 1650, the Dutch Secretary under Stuyvesant wrote to Holland to the effect that a suitable village site would be selected for the settlers. Before buildings were erected, the village site was to be surveyed, streets and lots were to be laid out, and the land outside the village was to be divided into tracts for cultivation. Tracts of woodland and pasture not allotted to individuals were traditionally used in common.

As a plan, it was far in advance of the prevailing procedure, but to what extent it met with general approval and was put into operation by the colonists is not known. The question of representative government agitated the minds of the settlers. England also viewed with disfavor the colonizing efforts of the Dutch in America and planned their dismissal. The first step in that direction was taken when in 1664, Charles II granted to his brother, the Duke of York, a charter which, among other tracts, included all the land between the Connecticut River and Delaware Bay. Then, by blockading New Amsterdam with his squadron, he secured its surrender in the same year. Thus, Holland lost its New Netherland colony to England, and New Amsterdam became New York. Under the English regime, extant evidence shows that some of the settlements used land divisions that were the result of design.

New Paltz, in the Valley of the Wallkill, is one of these settlements. New Paltz was founded by 12 Huguenot refugees from France, who had lived for some time in Mannheim, Germany. They had bought from the Indians a 36,000-acre tract of land, for which the governor issued a patent in 1677. At first, they cultivated some of the land in common. But one of their first acts was to divide the land into equitable tracts for assignment to the members of the group. As they had no surveying instruments, this was done by pacing along straight lines that intersected each other at approximately right angles. In this way, when viewed on aerial photographs, the pattern produced consists of nearly rectangular tracts that stand out as a distinct landscape feature and set the area apart from the surrounding country. But even after allotment of the tracts to party members, some of the pasture and woodland was kept for common use (21).

There are also indications that city developments received advance consideration. The extension of New York City north of Wall Street leads to that conclusion. Urban development of the city during colonial times did not extend far beyond Wall Street. However, the straight main streets and the regular spacing of the rectangular intersecting side streets north of the old city supply sufficiently convincing evidence of some planning for expansion.

Only the eastern half of the present State of New York was settled during the colonial period; the western part was developed after statehood was attained. Land divisions in these two parts of the State differ greatly. In the western part, as a rule, land divisions were laid out with systematic regularity before the land was sold to the settlers, while in the area of colonial settlement, the land divisions are largely the result of individual choice. Consequently, the arrangement and composition of the landownership pattern in rural communities usually is irregular.

New Jersey

In its earlier stages, the historical background of settlement and the acquisition of land titles in New Jersey is closely related to that of New York. No settlements were made in New Jersey under the London Company grant in Virginia or the Plymouth Company grant of the northeastern territory, both of which included that part of the country. During the Dutch occupation of New Amsterdam, some settlements were made on the western banks of the Hudson and its bays. Swedes had started settlements on both sides of the Delaware. Tracts of land back of Cape May

were bought from the Indians by other European nationals. Of these, the Swedes were first absorbed by the Dutch, and later, in 1664, the Dutch surrendered to the English when the latter asserted their supremacy as the colonizing power of North America. But even before the Dutch had surrendered to the English, the Duke of York granted the land between the Hudson and the Delaware to his two friends, Lord Berkeley and Sir Carteret. From that time on, the colony was known as New Jersey.

Difficulties beset the new colony from the beginning. Although the Land Proprietors had received the land as a royal grant, the governor of New York still promoted settlement in New Jersey and issued titles to the land, which were not recognized by the owners. In the governor's assembly in Elizabethtown, the question of validity of land titles became the principal issue. Many of the delegates from the settlement contended that their titles to the land, which were issued by the governor of New York, were valid; others argued that purchase of land from the Indians gave them valid titles. Opposition to the proprietors' management of the colony became intense; it reached a point at which the settlers refused to pay quitrents and even deposed Carteret as governor. Carteret in turn submitted the dispute to the King, who upheld the rights of Berkeley and Carteret as proprietors. At the same time, he restricted the authority of the New York governor to his colony.

Colonial development in New York and New Jersey were suddenly interrupted, in 1673, when the Dutch again arrived at the scene and regained temporary control of part of New York and New Jersey. They relinquished this control within a year, and, in 1674, it was restored to the English crown. The old grants to the proprietors were renewed – eastern New Jersey to Carteret – but in the meantime, the rights of Berkeley to western New Jersey had been transferred to two Quakers, John Fenwick and Edward Byllynge. Both were soon harassed by financial difficulties and became insolvent. William Penn and two other Quakers were appointed trustees; they acquired part of the holdings of the two men.

The reestablishment of English power on the Hudson was felt also in eastern New Jersey. The Duke of York had appointed a new governor for New York who at the same time was vested with authority to govern New Jersey. But Carteret did not accept the edict; he resisted the new order. Eventually, the authority of the New York governor was restricted, and New Jersey's independence of New York was acknowledged. In 1682, after Carteret's death, his widow sold his holdings in eastern New Jersey to William Penn and 11 associates, all of whom were living in England. Their shares were again divided and sold to an additional 12 associates, which increased the number of proprietors to 24. As a concomitant of the procedure, the proprietors had to relinquish their authority and functions of government, which were entrusted to an appointed governor.

Although eastern and western New Jersey had been merged, the former capitals, Perth Amboy and Burlington, were retained. Meetings of the colonial legislative body were held alternately in these places. The role of the proprietors in the affairs of New Jersey had been reduced to what has been said to be rent chargers. A number of proposals were advanced by the proprietors to divide the land among themselves, especially the land in the more desirable locations and town settlements. It is not clear, however, to what extent these proposals were acted upon. With the advancement of settlement, the land charges were increased and nonpayment or a partial

arrear in the payment of the quitrent were considered to be cause for forfeiture of all or part of the land settled. From the operational practice of the proprietors, it is clear that their interest was centered primarily on the receipt of rents rather than on an orderly disposal of the land to settlers (23).

The confusion created by the loose land transactions of the proprietors, and the multiple sources of land titles, may be better perceived from what a representative of New Jersey to the First Congress had to say on the situation. In the House debate on the disposal of public lands on December 27, 1790, the question of indiscriminate location as against approved land-office divisions came up for discussion.

Mr. Boudinot was against indiscriminate location. He had seen the bad effect of it in the State from which he came. Persons had bought up the lands, and sold them again to such as absolutely needed a water lot to their farms, at enormous prices. He mentioned another objection to the plan – the tendency it had to create law suits. He said more money had been spent at law, in disputes arising from that mode of settlement in New Jersey, than would have been necessary to purchase all the land of the State (72).

From that time on, New Jersey's population increased considerably. From an estimated 138,000 people at the time of the Revolution, it rose to nearly 5 million in 1950. When this increase is taken into consideration, it might be supposed that by now all the land of the early proprietors had been disposed of. But we are told that the two original corporations are still active. One, the East Jersey Proprietors, has its headquarters in Perth Amboy and the West Jersey Proprietors in Burlington. These two corporations are probably the oldest in the country. Both hold regular meetings for the purpose of exercising jurisdiction over unlocated land, appointing surveyors, settling title disputes, and electing officers. The minutes of the West Jersey Proprietors prove that the members of this corporation have met each year since 1677. The first meetings were held under a willow tree; two meetings are now held annually; one in Burlington, followed a few days later by a meeting of a branch of the corporation in Gloucester, N. J. (9).

Maryland and Delaware

All the territory that comprises the present States of Maryland and Delaware was included in the royal grant of Virginia, made in 1606, to the London Company, but was neglected as a settlement area. Aside from an Indian trading post on an island in the Susquehanna River, no other settlement was established on the upper Chesapeake Bay or the Potomac River during the lifetime of that company. The Virginia charter was revoked in 1624. In 1632, the King granted the Chesapeake-Potomac country to Cecilius Calvert, eldest son of the first Lord Baltimore. The country included in the grant was bounded on the north by the 40th parallel, on the south by the southern bank of the Potomac River, from its source to its mouth, thence eastward across Chesapeake Bay and the Peninsula to the Atlantic shore.

The charter of Maryland, as the colony was called, conferred upon Calvert and his successors, the fullest authority as the proprietor of the land and as head of the

colonial government with allegiance to the King. In reality, Maryland was an independent and self-governing colony. Not even customs, taxes, or other contributions could be exacted by England from the settlers or government of Maryland. Calvert himself organized and financed the transport of the first settlers — 20 gentlemen and 200 to 300 laborers and craftsmen. They arrived in the spring of 1634 on the Potomac side of southern Maryland, where they landed and founded St. Marys City.

Calvert's knowledge of government organization was necessarily derived largely from the existing pattern in his homeland, which still contained many feudal qualities. The regime Calvert established in his colony, however, was not an exact counterpart of the English Government. In Maryland, the settlers were given greater freedom in civil and religious tenets; they were encouraged to participate in the formulation of their laws under the guidance and authority of the proprietors of the manors and the governor and council of the colony. Calvert had incorporated these guiding concepts in the governmental structure of his colony.

A manor, with its craftsmen and indentured servants, was the focal point of the early settlements. The estate belonging to a manor was in keeping with the dignity of the owner. Frequently, it comprised thousands of acres. At the beginning, quitrents were low, but with the development of the country they rose. Servants were indentured for a short time only, usually for 3 years as compared with 6 or 7 years in other colonies. At the end of their term of service, they could claim 50 acres of land. Freemen could obtain warrants for a specified number of acres, the location of which was indicated in general terms but with no definite boundary description. Overlapping grants frequently resulted.

At first, settlement was confined almost entirely to the Tidewater Country of Chesapeake Bay and the Potomac River, but later it spread to Delaware Bay. The independent settlements established at the head of Delaware Bay by the Swedes and the Dutch were contested by England. With the surrender of the Dutch on the Hudson, these Delaware settlers also had to accept the English regime and the land was claimed by the Duke of York. This produced another boundary uncertainty.

The boundary between Maryland and Pennsylvania was already in dispute. The grant to Lord Baltimore had the 40th parallel as its northern boundary, while the grant to William Penn was tied to the position of New Castle on the Delaware. To obtain access to the bay and ocean, Penn obtained from the Duke of York, in 1682, deeds of feoffment that included the land within a 12-mile radius of New Castle and all the land lying south of it on Delaware Bay to Cape Henlopen. Although no definite boundary of the grant was indicated, it was clearly an encroachment on Maryland's charter territory. As such, it was opposed by the Maryland proprietary. An agreement between the contestants was finally reached in 1760. A commissioner and surveyors were appointed to locate the boundary between Maryland and Delaware, which was verified by the two English surveyors, Mason and Dixon, who also established the northern boundary of Maryland, which was known as the "Mason and Dixon Line (17)."

During the 17th century, settlement in Maryland was prevailingly rural. No outstanding city developed. St. Marys was the first site of the capital, which, in

1694, was moved to Annapolis, where it has since remained. The present city of Baltimore had a later start. When the large landholders on the Patapsco River felt the need of harbor facilities, they applied to the Provincial Assembly for a permit to prepare the foundation of a port city; it was granted them in 1729. Land was bought for that purpose, and in the following year, the city plan and building lots, from which the metropolitan city of Baltimore evolved, were laid out (5).

Pennsylvania

The territory of what now constitutes Pennsylvania was not completely uninhabited by Europeans when, in 1681, William Penn obtained his title to the land. Settlers from England, Holland, and Sweden had obtained land grants or bought land from the Indians. Most of these settlers had located on the Delaware and along the Schuylkill River. Aside from the claims of these settlers, William Penn's right to the land within the bounds of his charter was challenged by other colonies. Connecticut advanced a claim to the northern third of Pennsylvania based on its charter of 1662, and, in 1776, it organized Westmoreland County within that area. More than 200 Connecticut settlers with their families had located in this area. Penn tried to dislodge them by force but the settlers resisted. The dispute was settled when, in 1782, the arbitration court appointed by the Continental Congress awarded Cumberland County to Pennsylvania. The boundary dispute with the Maryland proprietary was mentioned in connection with the Maryland boundary. Even Virginia exerted her right, according to the old charter, by granting land to settlers in southwestern Pennsylvania as far north as Pittsburgh.

Shortly after Penn had received the charter to Pennsylvania, and while still in England, he started selling the land of his vast domain. These sales were made in the form of warrants that entitled the owner to a certain acreage or city lot in Pennsylvania without defining their locations. Penn arrived in his colony in 1682. One of his first acts after his arrival was the opening of a Land Office. In dealing with the Indians, William Penn insisted on having the Indian claims to the land extinguished before the land could be sold and deeded to settlers. This policy was adhered to by his successors, and later, it was followed by the State. Between the time of the first purchase in 1682, in Bucks County, and the last in 1792, the Erie Triangle, not less than 33 treaties and purchases were negotiated with the Indians to secure their right to the land (14).

William Penn's charter to Pennsylvania provided for a proprietary government, which, however, was not entirely independent of the government in England. All land patents were issued in Penn's name, but all of them contained the clause that a royalty on minerals extracted, proportionate to the value, was due the crown.

The governmental structure that was to be erected in Pennsylvania was indicated in the charter. Penn was empowered to divide the country into towns, hundreds, counties, boroughs and cities; and to erect manors, hold courtbaron, and view of frankpledge. To some extent, land-selling operations were adjusted to these medieval remnants of government. Accordingly, 78 manors were established in southeastern Pennsylvania, and most of these estates comprised thousands of acres each. However, the civil prerogatives of the manors did not last long; soon they were reduced to social

and economic values, of which the investment potential of the land was outstanding. Penn's main interest was oriented in the same direction, that is, it was centered on farmers and urban dwellers.

Penn had his own ideas of how a colony should be developed. He had sent his deputy governor and his surveyor general ahead of him to explore the country. They were instructed to select a suitable site for a great town, for which Penn and his surveyor had already drawn the plan. They chose the site on which Philadelphia is located, the place also at which Penn landed when he arrived in the colony. The streets were laid out according to his plan. For rural settlement, he had another regulation. As described by himself, in 1685, "We do settle in the way of Township or Villages each of which contains 5,000 acres, in square, and at least Ten Families; the regulation of the Country being a Family to each five hundred Acres" (26, pp. 17-18). As we now know, his city plan was a success, while his plan for rural development was used to some extent only in Germantown outside Philadelphia.

The requirements of the village type of settlement, as envisaged by Penn, were not so readily complied with by the settlers. It was difficult to find similarly minded groups of people who were willing to accept the prescribed form of land division and settlement. The land commissioners found it easier to accommodate individual settlers and land speculators by selling them the acreage they wished to acquire. From the experience gained, the general policy followed in the disposal of land evolved. Land was sold mainly in tracts of less than 500 acres. Later, in 1765, to eliminate speculators so far as possible, the maximum acreage that could be sold to an individual without special permission of the proprietor was reduced to 300 acres.

The usual procedure in obtaining title to vacant land was to buy a warrant for a certain acreage located in an established county, and in the vicinity of or adjoining a deed already issued. Price and quitrent terms were indicated in the document. The patent became valid only after the tract had been surveyed and recorded at the expense of the purchaser. But when the tide of immigrants coming from Europe was swelling, bringing chiefly people with little or no money, the legal requirements were frequently ignored. Furthermore, from 1718 to 1731, after the death of William Penn, the operations of the Land Office were almost suspended. Under these circumstances, a large proportion of the settlers went directly to the back country and located on vacant land as squatters.

Squatter settlements were made without benefit of any organization or regulation. Each squatter located wherever he found vacant land to his liking. Usually, squatter claims were ill-defined, and this in turn was the cause of many disputes. To adjust such disputes, they set up their own "fair play tribunals." As described for the area that now constitutes Lycoming County,

They formed a mutual compact among themselves and annually elected a tribunal in rotation of three settlers, who were to decide on controversies and settle disputed boundaries. From their decision there was no appeal and there could be no resistance. The decree was enforced by the whole body and the execution and eviction were as sudden and irresistible as judgment. Every newcomer was obliged to apply to this powerful tribunal and, upon his solemn engagement to submit in all respects to this law of the

land, he was permitted to take possession of some vacant spot. Their decrees were, however, just; and when 'fair play' had ceased, their decisions were received in evidence and confirmed by judgments of courts (26, p. 22).

Squatter's right as a title to land persists. Even now, many farmers in Pennsylvania have no other legal title to the land than the one based on squatter's right.

The Carolinas

In the early stages of American colonization, North Carolina and South Carolina were considered by the English to be a part of Virginia and by the Spaniards to be a part of Florida.

The first attempt at colonization along the coast was made by the Spaniards in 1526. Approximately 500 people were brought over from San Domingo and landed in Winyah Bay at the mouth of the Pee Dee River. But after a few months stay, when disease and Indian attacks had greatly depleted their number, they returned to San Domingo. France also tried to get a foothold on the South Atlantic shore, and in 1562, a number of Huguenots settled at Port Royal. However, they soon returned to France. Farther north, Walter Raleigh twice attempted to open a settlement on Roanoke Island and twice failed. The first settlers landed in 1585, but a year later they became discouraged and returned to England. In 1587, he brought a second group of settlers to the island. But when Raleigh's governor returned to Roanoke Island in 1591, he found the settlers gone, their fort and habitations destroyed, and the word "Croaton" cut into the bark of a tree. Their disappearance is a mystery to this day. This was the last of the 16th century attempts by Europeans to settle in this section of America.

Explorers and Indian traders from the James River settlement, however, had entered the country to the south, and a few had settled in southern Virginia, as it was called, by obtaining Indian titles to the land. The name Carolina was first applied to this section of the country in the grant of Charles I to Sir Robert Heath in 1629. But Heath failed to promote settlement. Three years after his return to the throne in 1660, Charles II granted the territory of Carolina to eight proprietors.

These proprietors were distinguished at Court, and they had full power of government, but they showed little aptitude in governing the colony. In the main, the governors they appointed were not qualified to deal with colonial problems. Dissatisfaction of the settlers with the proprietary government rose at times to a point at which they deposed the governors. Not the least of the grievances of the settlers were the uncertain and confusing terms of landownership. According to the proposal of the Land Proprietors, settlement was to be based on the old English feudal order. The "Grand Model" or Fundamental Constitution, drawn up by the English philosopher, John Locke, recognized three degrees of nobility – barons, caciques, and landgraves. Of these, the barons were entitled to landed estates of 12,000, the caciques to 24,000, and the landgraves to 48,000 acres (63, v. 1, p. 17). Land divisions were to be rectangular.

The territory was to be blocked off in squares of 12,000 acres, each of which was to remain a barony for a proprietor or a colony for commoners, as designated in the grant (25, p. 25).

Other disturbing elements harassed the people and the proprietary government of Carolina. The Indian menace was real. Settlers had to be armed at all times. The quitrent exacted by the proprietors was a source of contention. Dissension among the colonists on racial and religious grounds was another difficulty. The incursions of pirates along the coast were a persistent menace. To add to the discomfiture of the government, uncertainty as to boundaries between the colonies remained for decades a controversial issue, leaving in doubt the spatial limitation of juridical authority. The northern and southern boundaries of Carolina existed in name only as a geometric line mentioned in the documents of the grants. According to the terms of the first charter issued by Charles II in 1663, all the territory lying between latitudes 31° and 36° from the Atlantic to the Pacific Ocean was included in the Carolina grant. In the second charter, issued 2 years later, the boundary lines were moved to latitudes 29° S. and 36.5° N. Of these, the Virginia-Carolina boundary was the most bitterly contested; it was not settled until 1728, when a 240-mile stretch was run from the coast.

For almost 50 years of the proprietary regime, Carolina was administered as one colony, first from Albemarle and later from Charleston. From 1712 on, North and South Carolina were divided. Each had its own governor, but it was not until 1730 that the demarcation of the boundary line between the two colonies was attempted.

The division did not greatly improve conditions in the Carolina colonies. The old vexations hampered development as before. In fact, the Indians became more belligerent than ever and had to be subdued by the colonists. None of the campaign cost was shared by the proprietors. On the contrary, they raised the quitrent to four times the former rate, which incensed the colonists to the point of rebellion. They expelled the agents of the proprietors, elected their own governors, and petitioned the King to convert the Carolinas into royal colonies. The King consented to this, but it took 8 years to liquidate the claims of the proprietors. Not until this was done, in 1729, did the governing power revert to the King and the Carolinas become royal colonies. Thus ended the dream of establishing a government of feudal nobility in the Carolinas.

With improvements in government under the royal governors, and a freer land-acquisition procedure for the settlers, the development of the Carolinas progressed more rapidly. Settlers arrived in the Carolina harbors in increasing numbers. They penetrated the upper Coastal Plains by using the rivers as routes of travel. From there, some of the pioneers advanced to the Piedmont and settled there. In addition, toward the middle of the 18th century, many settlers entered the Carolinas from the north. Most of those who came from the north were emigrants from Pennsylvania – Scotch-Irish, Germans, and others. They came south on the wagon road in the Great Appalachian Valley and used the gaps in the Blue Ridge to reach the Piedmont on the eastern side. Much of the Carolina back country was settled in that way.

The physical background and composition of population produced regional distinctions in social conditions and settlement patterns. In the lowlands, where

settlement started, large estates and plantations with an admixture of smaller holdings were the components of the landownership picture. For the most part, they were located along the rivers and on the higher ground along the watercourses. The wet lands on the interstream flats remained unoccupied. Planters, their servants and workers, and the freemen farmers, skilled artisans, and professional men represented the prevailing social grouping of the people. On the Piedmont and in the Appalachian valleys, the settlers were mainly farmers who had selected and bought moderately sized tracts of land, which they themselves worked. Usually, the settlers were organized into communities, which frequently received a part of their coherence from ties of kinship among the settlers themselves. Illustrating the settlement pattern is a map of the Fourth Creek Congregation on the Piedmont of North Carolina, which was made in 1773 by William Sharpe, a settler. On this map, the location of the homesteads with the names of the occupants are indicated; family connections among the settlers may thus be deduced (49, p. 12).

Landownership was as poorly defined in the Carolinas as in other colonies. The metes and bounds surveys for the deeds were frequently executed without attempting identification or correlation of the survey with the boundaries of adjoining properties. This haphazard method and the lack of systematic procedure necessarily caused confusion and controversy among the settlers, and in the end, they led to court actions (41, pp. 84, 163; 24).

Georgia

In the chronological sequence of English colonization, Georgia was the last of the colonies founded on the South Atlantic seaboard. Most of the territory that now forms the State of Georgia was at first included in the Carolina charter, which was obtained by the proprietors in 1663. More than half a century later, in 1717, the English nobleman, Robert Montgomery, obtained from the Carolina proprietors a grant of land bounded by the Savannah and Altamaha Rivers, which he intended to settle. With this objective in mind, he published in the same year a pamphlet in which he described his scheme of settlement. Settlement in the margravate of Azilia, as he called the concession, was to be of the town or village type to fit into frontier conditions. Districts 20 miles square were to be laid out. Each of these districts was again to be subdivided into four squares, with the town or village located at the intersection of the dividing lines in the center of the district. The remaining land was to be divided symmetrically into lots a mile square with 4-mile square wood and pasture land common to each quarter, all of which was to be enclosed by a belt of woods 2 miles deep (27, p. 45 and illus. f. p. 146). Montgomery's settlement scheme was obviously an adaptation of the Roman colonial settlement system, but it did not materialize. The land remained in possession of the Carolina proprietors.

To settle this part of the country, in 1729, the English Crown reduced the grant of the Carolina proprietors southward by making the Savannah River the southern boundary. General Oglethorpe, and other influential courtiers, later petitioned King George II to establish in this southern territory a new colony. The petition was received with approval, and accordingly, in 1732, the King granted the colony of Georgia an independent charter and appointed Oglethorpe as its governor. The land

included in the colony was bounded by the Savannah and Altamaha Rivers, and extended westward to the "South Sea." In February of the following year, Oglethorpe arrived with the first settlers at the mouth of the Savannah River, where he laid out the plan of the town that later took its name from the river. One of the first acts of Oglethorpe was to negotiate with the chiefs of the Creek Nation a treaty in which the Indians agreed to transfer to the settlers rights to the land they did not need. Many similar treaties were concluded with the Indians by the colony and later, by the State.

Settlement was at first confined to a belt along the coast, which extended inland along the southern bank of the Savannah River. Each family was allotted 50 acres of land, and the ownership of noncontiguous tracts was restricted to 500 acres. Under the charter, the colony was organized and operated as a corporation under the "Trustees for establishing the colony of Georgia in America." This changed when, in 1752, the trustees surrendered their charter to the crown. As a result, Georgia became a Royal Colony, with a somewhat different policy orientation. Settlement also transgressed the boundary lines of the old charter. Shortly after Florida was ceded to England in February 1763, the governor of South Carolina, knowing that the land south of the Altamaha River was not included in the Georgia charter, issued a number of grants to land lying between the Altamaha and St. Mary's Rivers. Most of these grants comprised 1,000 or 2,000 acres each. This action was protested by the General Assembly of Georgia. In response, the King, by proclamation in the fall of 1763, annexed the land lying between the Savannah and St. Mary's Rivers to the province of Georgia. This gave Georgia its present southern boundary.

Settlement in Georgia progressed slowly; at the time Georgia attained statehood, the occupied land was still confined to the more accessible land along the coast and the Savannah River. From 1777 to 1783, to accelerate the process of development, the Legislature of the State passed a number of acts in which the head right of the settlers was included in the provisions. Each free person or head of a household was entitled to 200 acres of land, and for each family member, white or Negro, he could claim an additional 50 acres. The acreage a family head could acquire under these conditions was at first limited to 500 acres. This restriction was later expanded to 1,000 acres. Special provision had been made for special uses. A person could obtain 100 acres of vacant land for erection of a grist mill, 500 acres for a sawmill, and for the erection of a forge, a bloomery, or a furnace, he was entitled to 2,000 acres. These were the inducements that helped to step up Georgia's land office business. Land was granted not only on legal grounds; the many fraudulent grants ranged in size from 10,000 to half a million acres.

The counties in the coastal region and the land located between the Savannah and Altamaha-Oconee Rivers are still referred to as the headright counties, in contrast to the land-lot counties to the west (32). In some of the headright counties established in the area by 1796, there was at that time a considerable acreage of vacant land. In others, land grants had been pyramided. With no proper surveys made of these grants, the validity of the land titles became an issue. In 1798, a law was passed that required processing of the boundaries of these grants by the owners, but it proved to be ineffective.

Later on, a check of the records by the Surveyor General revealed that in three of these counties the grants totaled more than 10 times the land area of the individual

counties. In the report of the Surveyor-General to the State Legislature, the land area and the acreage granted were itemized for each of the headright counties and summarized for the entire area.

This report of the Surveyor-General was made June 17, 1839, and shows that the twenty-four counties existing in 1796 contained actually 8,717,960 acres of land, whereas the maps and records of the Surveyor-General's office show that in these counties there had been granted 29,097,866 acres (45, p. 57).

The comparison illustrates how the prevailing loose methods of land acquisition in the early stages of settlement produced uncertainties and confusion in landownership.

The Trans-Appalachian Country

In colonial times, the western slopes of the Appalachians were known as the "Land of the Western Waters." According to the colonial charters, they belonged partly to Virginia and partly to Carolina. The mode of settlement and development of this part of the country, from which the States of Tennessee, Kentucky, and West Virginia emerged, differs in many respects from that of the mother colonies.

In the mother colonies, settlement was not systematized to any extent but in most of the Land of the Western Waters, settlement regulations were even less in evidence. Throughout much of the region, so long as there was plenty of vacant land, location of homesteads was primarily a matter of individual choice. Some large tracts of the better land had been granted to land companies and individuals. Usually, however, the boundaries of these claims were ill-defined, which made the acquisition of land by actual settlers a precarious venture. The occurrence of these and other variables in the process of settling this land can usually be associated with the prevailing surface features of the region. The distribution of mountains, ridges, basins, and valleys, both broad and narrow, influenced greatly the occupation of the land and produced the great diversity in the settlement pattern.

When the first hunters and Indian traders crossed the Appalachians, nothing but Indian traces (trails), which were too narrow even to accommodate pack animals, existed. Under these conditions, the mountains imposed a formidable obstacle to westward expansion of settlement. So effective were the mountains in holding back the people that up to the latter part of the colonial period, they constituted the frontier of settlement. Effective occupation was further complicated by the conflict of interest among the colonizing powers. The English on the Atlantic side claimed the western slopes, and so did the French, who claimed the Mississippi Valley. A royal order even went so far as to restrict the issuance of land grants on the western waters which, however, was not taken too seriously by either officials or the people. Hunters, explorers, and Indian traders entered the region from the East as early as 1671; from the West, the French entered as early as 1714 (1, p. 34; 64, p. 45). These dates mark the entrance of the first individuals into the backwoods of the mountains; it was followed by an increasing number of hunters and traders. Their experiences provided the meager background information for the early settlers of the Trans-Appalachian country.

Combined with the natural obstacles that delayed settlement was the at times menacing and unstable attitude of the Indians toward the settlers. It cannot be said that the entire region was inhabited by Indians. But there were Indian congregations in the southern part, chiefly along the Tennessee and its tributaries, and on the Ohio. Lying between these rivers was an extensive stretch of country, in which game was plentiful, and which was used by the Indians almost exclusively as a hunting ground. The area also contains some of the battlegrounds of the French and Indian War (1754-63) during which settlement was almost at a standstill. With peace established, settlers began to arrive again. Carolinians and Virginians crossed the Blue Ridge, where they were joined by others coming down from Pennsylvania in the Central Appalachian Valley. These pioneers either followed the valley south to the headwaters of the Tennessee, from which they spread from valley to valley, or they used the gaps in the Cumberland and Allegheny Mountains to reach the interior. Other bands of settlers crossed the mountains farther north toward Fort Pitt (Pittsburgh) and used the Ohio River as the route of penetration. These main routes led to the larger areas of favorable ground, where settlers began to concentrate and where forts had been erected for the protection of the people. Of these, central Kentucky and the central basin of Tennessee became the best known.

The land on the western waters had its speculative promoters also. This is particularly true of what became known as the Bluegrass Region of Kentucky, which had acquired the reputation of being the best land in Virginia. Contrary to the King's order of 1763, which forbade settlement west of the Alleghenies, land companies began to operate and pioneers entered the region from the East to start settlements. The first permanent settlement in Kentucky was made at Harrodsburg in 1774 by a group of adventurers under the leadership of Captain James Harrod. The most notorious of the land speculators was Colonel Richard Henderson of North Carolina, who had acquired Indian titles to immense tracts of land located on the Ohio, Kentucky, Cumberland, and Tennessee Rivers. He organized the Transylvania Company with Daniel Boone as one of the agents. Boone and his companions arrived on Otter Creek, Ky., in 1775, where they erected a fort and laid out the town of Boonesborough, which served as headquarters of the company. Although the governors of Virginia and North Carolina censured the venture, within the next 15 months 900 claims comprising 560,000 acres had been registered by the company (11, p. 443). The operations of the company declined after the Virginia assembly, in 1776, passed an act in which Kentucky was established as a Virginia county. Eventually, the company closed its office.

Settlement of the western lands slowed up at the beginning of the Revolutionary War, but even before the termination of hostilities, the stream of new settlers that crossed the mountains began to swell again. In the meantime, conditions of settlement had changed also. Land grants and titles, which formerly were issued by the proprietary governors or the appointed officials of the King of England, were now issued by the sovereign States. But the newly elected State officials were no more experienced in dealing with and systematizing the alienation of their public lands than were the colonial officials, nor did they have the means with which to implement any advanced land divisions and land-quality surveys. On the contrary, land was used as the medium of discharging their obligations, especially toward the soldiers of the French-Indian and Revolutionary Wars. As by that time, not enough vacant land was left east of the mountains, most of the soldiers' warrants to land had to be applied to the lands west of the mountains. This was done by North Carolina and Virginia.

Virginia went further and expanded this point of her settlement program. When the question of relinquishing eastern State claims to western lands in favor of the United States was discussed by the Congress, Virginia contended that there was not sufficient land south of the Ohio with which to compensate the Virginia soldiers of the Revolutionary War. When, therefore, Virginia ceded her vast land claims northwest of the Ohio to the Union, the State reserved for settlement purposes the tract of land located between the Scioto and Little Miami Rivers. Consequently, the Virginia Military District, as this tract is known with reference to land divisions, was not included in the public domain of the United States and was not subdivided into townships and ranges. This district was settled by Virginia soldiers, or their assignees, in the old indiscriminate way.

In granting bounty land to soldiers, Virginia was generous. Acreages granted ranged from 100 acres for soldiers with less than 3 years service to 15,000 for a Major General. It has been said that more than twice as much land was needed to compensate the soldiers of the Virginia line than was needed for all the other soldiers of the Continental Army. The site selection of the land, for which warrants had been issued, was left to the settlers. The first to arrive selected the best land and frequently bounded it without regard to shape or contiguous claims. Some incongruently shaped tracts resulted. Others were not particularly scrupulous in surveying their claims. A case is reported (Survey No. 15890 on Turkey Creek, Scioto Co.) in which, in 1850, the computed acreage from the original survey and patented, was 450 acres, while the parcels sold from this tract totaled 1,662.26 acres (67, p. 32).

Virginia's generosity in granting land was not confined to soldiers. Notwithstanding the royal order prohibiting settlement west of the Alleghenies, many settlers had drifted in and located on the land without having, or being able to obtain, title to it. The Virginia Assembly, in the "Land Law" passed in 1779, tried to remedy this situation. According to this law, the older settlers who had built homes and had grown some crops were entitled to preempt the land with its improvements up to a maximum of 1,000 acres. Settlers who had established themselves in the area after January 1, 1778, built houses, and raised crops were restricted to 400 acres. To facilitate registration of preemption claims, Virginia divided its western lands into four registration districts, each with a land office. Kentucky County was one of them. To adjudicate these land claims, a land court, composed of four commissioners, was created by the Virginia Assembly for the duration of 8 months. Court sessions were held in different parts of Kentucky during the winter of 1779-80. During this time, the court was in session for 79 days and passed upon more than 1,400 claims, or an average of 17 a day. In these sessions, certificates were granted for nearly 3,500,000 acres of land, or nearly one-eighth of the present State of Kentucky (73, p. 31). It is obvious from the procedure that the court could not have examined and verified the boundaries of the adjudicated claims in the field. The time limitation alone made field inspection impossible.

In addition to land granted to bona fide settlers, the Virginia assembly also granted land to a number of speculators. Land grants of this kind were obtained for large tracts, which usually ran into thousands of acres each. The surveys made of the land granted by the State or sold by the speculators were cursory in both concept and execution. Boundary markings of individual tracts, if any, were so few and inconspicuous that the boundaries could not be identified. In fact, some of the

landlines were computed only on paper and were not laid out on the ground. Thus there were inherent difficulties in describing the metes and bounds of such surveys. As a result, claims were superimposed upon others. As one writer remarks, "land claims in Kentucky overlapped each other like shingles on a roof and titles were so subject to controversy that it would have been impossible to determine who were the freeholders" entitled to a vote (1, pp. 76-77). The French botanist, Michaux, who traveled through the region in 1802, also made some pertinent observations on the settlers' security. He reported, "This insecurity in the right of property is an inexhaustible source of tedious and expensive law-suits, which serve to enrich the professional gentlemen of the country" (57, p. 228). Victims of this process had no redress. Ejection of families from the homes they thought their own was not uncommon.

The best-known case on record is the one of Thomas Lincoln, the father of President Lincoln. The first farm Thomas Lincoln bought in Hardin County, in 1803, was sold with a loss of 38 overlapping acres. He was deprived of the second farm he bought in a lawsuit, in which he lost the cash payment on the farm and had to pay the cost of the suit. He lost a third farm he had bought on Knob Creek through an ejectment suit (46). After the Lincolns had been dispossessed of three farms, they decided, in the fall of 1816, to leave Kentucky and move to Indiana. Abraham Lincoln, then nearly 8 years old, left with them as a matter of course. Thus, Kentucky lost an illustrious son.

Landownership was one of the principal issues that agitated the minds of the settlers on the western frontier. Almost everyone was affected by the complications resulting from the lack of proper regulations under whatever jurisdiction. At first, all the lands on the western waters were considered to be a part of Virginia. With the separation from the Virginia charter claims of the Carolina Territory in 1663, the westward extension south of the Virginia border became a part of Carolina. But the early settlers in the western Appalachians were not particularly concerned with the juridical divisions of the wilderness. In fact, before the boundary line was laid out on the ground, settlers near the boundary did not know on which side they were located.

In the Carolina sector, colonists from east of the mountains began to settle, around 1770, at the headwaters of the Tennessee near the Watauga River. The settlers had no title to the land, but after Henderson had organized the Transylvania Company in 1775, they bought the land from the company. Once settlement had started, a stream of new settlers from the East and the North poured in and spread over the western country. In 1778, after the demise of the Transylvania Company, the State opened its own land office in the western territory. But when, in 1784, the North Carolina Assembly again closed the land office, to offer the western lands to the Congress, it also nullified all entries. This left the settlers, temporarily at least, without proper land titles.

By that time, a considerable number of pioneers had settled in the western territory. They had become aware that mutual assistance, collective counsel, and action were essential in the struggle for survival on the frontier. As they were left to their own devices, they organized a territorial government, and, in 1785, established the State of Franklin, which functioned until 1788, when it was dissolved. However, it was soon revived as the State of Tennessee, which was admitted to the Union in 1796.

Land speculation became as rife in Tennessee as it was in the other States that evolved from the colonies. The early settlers who had claims by virtue of land occupancy took advantage of the prevailing contingencies to enlarge their holdings. The State Constitution gave the settlers the right of preemption and occupation of the tracts they held. Soldier warrants to land could be bought also. Boundary definitions reflected frontier conditions. Markings and surveys of boundaries were poorly executed, and this injected the usual complications into questions of landownership.

Tennessee was the second district of the western waters to be separated from the older settlements to the east – in this instance, from North Carolina. The Kentucky district to the north had attained Statehood and was admitted to the Union in 1792. West Virginia was the last to become a self-governing State. It was separated from Virginia in 1861, and was admitted by the Congress, in 1863, as a member State of the Union. All these western districts had to struggle to attain the status of a self-governing community.

Although the West Virginians were the last of the Appalachian frontiersmen to attain statehood, probably they were the first to request it. Settlers in the north-western part of Virginia petitioned the Continental Congress as far back as 1776 to separate that part of the land on the western waters from Virginia and to establish it as the State of Westsylvania. The Congress did not act on the request. Land questions were involved. Philadelphia merchants had acquired the Indian titles to lands of the former promoters and had organized a new settlement, called "Indiana," south-east of the Ohio. They appealed to the Virginia Assembly to recognize their claims, but Virginia was not in favor of the scheme and questioned the validity of the Indian titles to the land. As a countermove, Virginia opened its own land office in the district.

Colonial land grants in the "Northern Neck" of Virginia provided another bone of contention between the State and the landowners. The most disputed case was the Royal grant of the remaining waste and ungranted land in this section of Virginia to Lord Fairfax. At the time of his death in 1781, the aggregate of his real estate, which he had assigned to Denny Martin, a relative, amounted to about 300,000 acres. But the Virginia Assembly had annulled his title to the land and had sold tracts of it to settlers. The peace treaty of 1783, however, safeguarded the rights of the loyalists to the lands granted them by the King. In order to establish his rights to the Fairfax lands, Martin instituted an ejection suit against one of the settlers who had bought land from the State. The ejection procedure was initiated at the District Court of Winchester, which decided the case in favor of Martin. Later, the decision was taken to the Virginia Court of Appeals, which reversed the Winchester decision. Finally, a review of the case by the United States Supreme Court, in 1813, confirmed and made effective the Winchester decision (2). As a case of landownership, it illustrates the fact that in tracing colonial land titles, even international agreements may be involved.

The Colonial Territory as a Whole

There was no strictly uniform or standardized procedure in the colonies for acquiring landed property. A review of the land-disposal practices in the colonies was necessary to gain some insight into the operations of the land agencies that produced the vexing problems of landownership in the Eastern States.

As a group, the New England colonies came nearest to evolving a similar method of settlement and assignment of land to the people. Settlement by townships with land divisions within the townships was a unique device used in New England. Although there was no uniformity in size and shape of townships or individual holdings, the laying out of township lines ahead of settlement was a more or less established practice. In this respect, acquisition of land in the New England colonies differed from that in other colonies, and because of this, it is frequently referred to as the township type of settlement.

In the other colonies to the south, in which the proprietary form of government was prevalent, no such unifying procedure in settlement developed. In any attempt to classify land-acquisition practices in these colonies, the lack of any uniform procedure provides the outstanding characteristic. As a form of settlement without any particular order, it is usually called the "indiscriminate" type of settlement.

Not all the land in the original States and the States that evolved on the western slopes of the Appalachians, was disposed of without previous division surveys. Knowing the unrest created by unregulated settlement, all the States that had large tracts of unappropriated land at the conclusion of the Revolutionary War, tried to prevent the expansion of confusion. After the States had acquired some administrative experience, these tracts were divided into rectangular lots, either by land companies who had acquired the land or by the States themselves. In most instances, the rectangular division systems used for the purpose was improvised to fit local needs and conditions. As a rule, therefore, it did not conform to the national system used on the public domain of the United States.

The largest area divided into rectangular divisions for settlement and administration is the public domain of the United States. It was initiated in Ohio in 1785. From then on, it expanded, with various improvements, over the Northwest Territory and to the later additions to the public domain of Continental United States, which comprise approximately 2 million square miles. The objective of this survey was to guard against a repetition of the colonial disorder, confusion, and litigation connected with landownership and to produce a reliable and easy system of describing and identifying landownership that would be equally suited to the recording of land titles. The law that established the system is one of the earliest enactments of the Congress. It was introduced in 1783 and passed with amendments the following year. The system is still in use and in this respect, it has fulfilled the expectations of its promoters. As a rule, land acquired from the Federal public domain is not subjected to the uncertainties of boundary definition as was the land in the colonial territory. Consequently, it lies outside the scope of this discussion.

Georgia and Ohio are border States included in this discussion, although only a comparatively small proportion was settled indiscriminately. In the remaining parts of these States, rectangular divisions were applied. However, not all of them conform to the national system. The spatial distribution of the different land-division types in the United States is shown on the map inside the cover page.

UNCERTAIN PROPERTY BOUNDARIES

Much has been accomplished in the 175 years of national independence in the direction of scientific and technological advancement, and in the improvement of the economic and social well-being of the people. Equally remarkable has been the increase in population in the Colonial Territory during that time. At the close of the Revolutionary War, the population was approximately 3 million people. In 1950, it totaled for the same area 63 million, of which more than 41 million resided in urbanized areas. Such tremendous changes could not fail to bring in their wake equally strong reactions in land use and land values.

Near the end of the 18th century, unappropriated land still was plentiful in some of the original States. Practically all of it has now been disposed of. Furthermore, during the first century of our national autonomy, rural land values were held down by the steady westward expansion of settlement on virgin land. It was the period of internal growth in which the energies and material support of the country were directed primarily toward settlement of the land and development of its natural resources. But, as it happened, while the national resource base was undergoing expansion, the proper implementation of the administrative functions of government in the earlier settlement territory was overlooked. No cadaster of rural land, worthy of its name, exists in any of these States.

Industrialization of production and urbanization of population during the last century profoundly affected the living conditions of a majority of the people. This is particularly true of the territory of early settlement, where nearly 70 percent of the population is now urbanized.

With the concentration of people in cities, the internal structure of city administration also differs markedly from the structures of rural communities, especially when real estate is involved. In cities and their environs, land values are always high enough to warrant the greater care in dealing with land and its use that is usually prescribed in building codes and safety and aesthetic standards. Cities could not be developed without safeguarding social values to a certain extent, and they could not be administered without an adequate survey of the land to record how much is owned by whom, how it is used, and its tax value. The location, installation, and operation of transportation and communication facilities and of sanitation and utility services depend upon such a survey. Although urban and rural land records have similarities, they have pronounced differences also. The most obvious distinction is the indifference toward soil characteristics in evaluation of urban land. As a rule, tax or sales values of city property are not influenced by the quality of the soil, as is true of land for rural uses. Site location and buildings erected on particular sites are more important. These are fundamental differences that keep urban and rural cadasters apart. They explain also why this discussion is devoted exclusively to conditions in rural areas.

In contrast to the attention received by urban real estate, very little has been done in rural areas to obtain a uniform reliable foundation for administrative action when land ownership and land use are involved. Moreover, throughout large districts of the Colonial Territory, this situation is not confined to the spatial uncertainties of landownership; it extends to the problematical location of county and minor civil

division boundaries as well. In some instances, even State boundaries are uncertain. Indefinite boundaries are therefore found on three juridical levels – the county, the State, and the United States. All are the aftermath of the loose procedures in the issuance of land titles, and the equally loose administrative structure of government in colonial times and during the transition period to statehood. The abundance of raw land and its low value had much to do with it.

Since that time, a good many boundary disputes between adjoining proprietors have been adjusted through compromise or decided through court action, especially in the more densely settled areas. Fraudulent land grants have been revoked. Adjustments of this kind clear up individual cases but do not solve the problem as a whole. If we revert, for instance, to the principle enunciated at the International Statistical Congress at Brussels more than 100 years ago (see p. 21) "that the cadaster be the foundation of statistics pertaining to the land, of the statistics of agriculture, of the mortgage system, of farm credit, in short to be the source that contains the answer to all questions concerning real property," the present status of land records in rural areas in the early settlement territory is chaotic.

We do not have complete sets of county figures with which to demonstrate the existing statistical inconsistencies in all parts of the Colonial Territory. However, such figures have been compiled for Kentucky, North Carolina, Virginia, West Virginia, and Tennessee. They permit comparison of the land area of the county as a whole with the composite total of the land on the tax roll occupied by towns and villages and the land publicly owned and used. As these figures reveal, there is little harmony between the total land area of counties as used by the census, and acreages obtained from county offices. There are significant plus and minus departures, with no consistent trend apparent as to the preponderance of either excesses or deficiencies.

In Kentucky, the land not accounted for comprises very nearly 5 percent of the State's total land area, or 1,275,000 acres, which are distributed over 96 counties (53). The remaining 24 counties register nearly 290,000 acres in excess of the counties' total land area. If we accord credence to these figures, the indications are that approximately one million acres of unappropriated land are scattered over the State of Kentucky. But such a supposition is difficult, if not impossible, to verify, at least from existing records. As a geologist observed some years ago about eastern Kentucky, "boundaries of farms and mineral and timber tracts are indefinite and land titles in general are in a chaotic condition (58, p. 191)." No doubt, a similar situation prevails over much of the part of the State east of the Tennessee River. The Jackson Purchase west of the river was divided into sections before it was settled.

In North Carolina, the acreage not accounted for in 73 counties exceeds by far the excess reported by 27 counties (54). Actual acreage reported in the first group is 1,013,000 acres less than the census acreage, as against 476,000 excess acres reported for the second group. In the second category are two counties, one in the mountains, the other in the lowlands (Transylvania and Dare Counties), which combined register 37 percent of the total excess. Such uncertainties in landownership records also are a formidable handicap in the study and analysis of problems connected with adjustment of the use of the land to its physical potentiality. As experienced in a pilot study of the Lower Coastal Plain, "Land titles are at present almost entirely dependent on verbal site descriptions which are frequently in uncertain terms (51, p. 23)." "

An actual land-development project is necessarily beset by the same difficulties, which cannot be bypassed if the project is to be established and operated in harmony with the adjoining neighbors. How the boundaries came into the picture and what had to be done is told by Dr. Hofmann, founder of the School of Forestry at the North Carolina State College, for whom the school forest was named. He was instrumental in acquiring the 78,000-acre forest laboratory, which comprised a land grant in Jones-Onslow Counties made by the State before the end of the 18th century. He says in part:

Boundary location was one of the first requirements in getting the land under control. The total distance around the forest is more than 125 miles with the boundaries often located at the wishes of the adjoining land owners. All surveys in this section are by metes and bounds or perhaps better described by a student in an examination when he stated: "The surveys are by leaps and bounds."

After almost 20 years nearly all of the boundaries are located, many by agreement and adjustment. When a line calls for N 20° 30° E - 2400 feet D. B. H. it is rather difficult to locate the exact point. As a forester D. B. H. means diameter breast high to me but I did not recognize the term in surveying until I found it meant "distance by hollering."

Practically all tracts of land are plotted by a closed survey but the last line invariably reads "from thence to point of beginning," which means it was closed from the point where the last course and distance ended. These confusing survey methods cause no end of boundary claims and misunderstandings.

In most cases a fair adjustment can be worked out although some become involved and difficult to settle. Public relations in all of its phases is the basis for solving these situations and the cooperation of the people, who are our neighbors, has been very helpful and commendable. One boundary line agreement required 57 signatures (36).

As a case history, the account not only throws light on the boundary situation; it also points out how the boundary problem can be solved.

In Virginia, the sequence in order of relative importance, of the minus and plus departures from the total land area of the counties, is reversed (55). Of the counties exclusive of the independent cities and Arlington, 44 report a larger excess acreage as opposed to the acreage deficiency in 55 counties when compared with the total land area. The respective acreage for the first group is 554,000 acres in excess; for the second group, it is 370,000 acres less. But in one county, Allegheny, the excess reaches 80 percent of the total land area. Such a disparity is hard to reconcile. It cannot be explained by the general formula of crossline acreage, in which a surplus acreage accumulates from the land lying across the county boundary and is reported by the owner in the county in which he resides. The counties surrounding Allegheny County report only small acreage deficits. Allegheny County lies in the hilly western part of Virginia. In hilly country land surveys with the old method, in which sloping lines were measured without reducing the measures to horizontal distances, may be expected to produce a surplus acreage. In this instance, however, most of the terrain

is not steep enough to account for a surplus of such proportions. Probably an overlapping acreage is involved. Although this is an extreme case, the statistical discrepancies of the counties as a whole are sufficiently pronounced to indicate the inadequacy of the records.

Those who conduct studies of land use and ownership necessarily take notice of these conditions. The development of the area is affected by them. As reported from Fluvanna County, Va.:

The poorly defined boundaries and often conflicting descriptions of properties frequently found during the field survey represented another obstacle to development in the past. All too often, litigation over the location of the boundaries between properties had proved expensive for the disputants. Uncertainty over the location and area within a particular tract had often been a source of trouble not only to individuals who were investing in real estate, but a deterrent to those who sought capital with which to acquire and improve land.

Many of these difficulties with boundaries traced back to inadequate surveys and overlapping of patents, which were granted when the area was first settled. The problem had been further compounded by frequent subdivision, disappearance of points of identification, accumulation of error through successive resurveys, and the copying of old descriptions without notation of all previous changes.

Particularly when no recent survey had been made, some of the descriptions examined in 1945 merely conveyed so many acres located near "Kent's store," "3 miles east of Wilmington," or "near Logan land." If the adjoining owners were identified, the identification applied only to the tract at the time conveyance was last made, possibly many years previously.

Even when fairly detailed surveys were available, points of origin were given which might be difficult if not impossible to reestablish by a future survey. These include such statements as "beginning in the old hedge on Owens line," "beginning at the northern-most point of the property," and "beginning in the old field." "An old stump," "a pine on a branch," and "a White Oak" were among the many illustrations of markers used for identification purposes. These markers might be difficult to identify, particularly after a lapse of time.

If the point of origin could be established and the distance between points had been accurately given in the previous description, the boundaries of the tract could be readily found. That is, the boundaries could be found, provided that these directions and distances - "South - degrees East - rods" or "North - degrees West - rods" were related to true north, or, if to the magnetic north, the date of the compass reading had also been recorded.

Usually, when plot maps were included with the description of a property, they denoted directions and distance between readily identifiable points,

as well as the date of the survey. Unfortunately, especially for most of the earlier transfers, plot maps were not made, or at least were not recorded (33, pp. 46-47).

In West Virginia, nine counties did not report, and to that extent the statistics are incomplete (52). For the counties that reported, the magnitude of the discordant acreage totals follow the same trend as in Virginia. The total excess is 248,000 acres reported from 30 counties, four times the deficit of 60,000 acres reported from 16 counties. Therefore, excess acreage indicates defective records. As acreage records are derived from the land surveys, it is evident that the original surveys were defective. A case of this kind was brought to the attention of this writer some years ago while working in Nicholas County. No assessed acreage is included in the statistics for this county. In this particular case, the boundary of a tract of land had been surveyed three times by three different surveyors, who followed the metes and bounds description in the deed. Each surveyor had located the boundary line in a different position. Although this is only a random example of indefinite boundary location, the indications are that it is not an exception.

In Tennessee, the land inventory is incomplete (56). From 50 counties, more than half those in the State, the assessed acreage of privately owned land was not available. Of the remaining counties, 34 reported 411,000 acres less than the total land area, while for 11 counties, the acreage listed exceeds the total land area by 98,000 acres.

Several contingencies may have prevented such a large number of counties from supplying the information desired. One of them may have been related to the physical difficulties encountered by early surveyors in the rough and mountainous country and the consequent doubtful determination of acreage. However, a location check of the counties with the physiographic regions of the State revealed no consistent relationship. Only a part of the mountain counties reported. This may be said also of the central and western counties. Therefore, other factors were involved; they may be sought in the prevailing assessment practices.

Assessment and taxation of real property can pose problems, which, if not properly resolved, can agitate the minds of the people. In colonial days, the arbitrary increase in quitrent incensed the affected settlers just as much as the Stamp Act incensed those in the rest of the colonies. Assessment of real property is now regarded as one of the main administrative functions of local government. But fundamental problems of land boundaries and records remain unsolved, as is evident from the reports of assessing officers' associations and committee publications. As described for the Southeast, an

Inequitable assessment of individual properties is apparently the most common, the most significant, and by far the most demoralizing of all problems of property tax administration.

Assessment in the Southeast still depends largely upon self-listing and self-assessment followed by "equalization" at the hands of local assessors. Self-listing of property has long been recognized as inadequate; it has sometimes been referred to as a "farce" and a classic example of wholesale "fraud."

Assessment of personal property of individuals in some States of the Southeast depends almost totally on voluntary listing and evaluation by the owner. Assessment of real estate is often almost as haphazard. In view of this fact it is not surprising that the great bulk of personal property is not even reported for taxation and that much real property is assessed at widely varying percentages of its value. One official has expressed the belief that a more equitable distribution of the tax burden would result if property values were assigned by lottery (71, pp. 15-17).

Real property evaluated by the owners for taxation purposes is a method of assessment in which progress moves in reverse gear; it takes us back to early Roman times. It is the procedure as prescribed by Servius Tullius for the Romans 25 centuries ago except that in the modern version the old penalties for misrepresentation are not imposed. Such an archaic system of taxation with valuation based largely on the subjective judgment of property owners is certain to produce many inconsistencies and disparities in assessment. The resulting inequitable assessments inevitably bring in their wake many discontented taxpayers.

Another aspect of the situation created by uncertain spatial definition of real property manifests itself in human behavior. Indefinite property boundaries between neighbors are likely to be the cause of friction as they affect the use rights of the land. Estrangement of this nature may even extend to community life itself. Usually, in such instances, discord among people does not result from differences in ideological concepts. The ill-defined spatial limits of property rights make ownership and use of land an object of contention and strife.

Observations in this direction have been recorded by a Georgian who is well acquainted with the land and people of the district in which he lives and which he described. He is the senior author of a local history in which he departs from the theme to call attention to the reaction of the people to indeterminate property boundaries. To his account of the ownership of the Okefenokee Swamp, he adds his observations of how the headright method of settlement during colonial days and the first years of statehood affected the people. He says:

I am tempted to digress a moment to comment that the old system of acquiring lands from the State, under the Headright method, caused more law-suits, more disputes and deadly enmity among neighbors than any other one thing ever devised by the Legislature of Georgia (47, p. 66).

It cannot be gainsaid that indefinite property boundaries are an inexhaustible source of dispute and controversy. Resident landowners are more exposed to the vexing consequences of uncertain property boundaries than are nonresident landowners. But nonresident landowners may encounter other difficulties. For example, a nonresident landowner tried to have the overlapping land claims with one of his neighbors settled through court arbitration. He could not find in the county a lawyer who would take his case. As these illustrations indicate, a different approach is needed to disentangle these boundary complexities.

INDEFINITE POLITICAL DIVISIONS AND PUBLIC LAND BOUNDARIES

Organized government cannot function effectively without having an established system of spatial divisions and subdivisions of the country to which by degrees the governing authority has been delegated.

In this country, the States have a considerable degree of autonomy in framing, promulgating, and enforcing their own laws. These laws are not uniform, and their legality ends at the State boundary. In the Eastern States, the State boundaries are usually those inherited from the colonies. When the colonies were established, their boundaries were usually ill-defined and the cause of disputes among the proprietary governors. The present State boundaries often represent, therefore, the adjudicated colonial claims with the boundary marked on the ground. But the process of defining the boundaries on the ground has not been carried out consistently in all instances, especially where the Trans-Appalachian States were separated from the Atlantic mother countries. There are still indefinite places in the State boundaries.

Counties as divisions of States, and districts or townships as subdivisions of counties, do not function in all States in the same way. For instance, in New England, local government functions are centered more in the towns than in the county; in other States, the reverse is true. But even with the functions of the districts restricted, definite boundaries are needed. People who live near uncertain district boundaries are in a quandary when they attempt to discharge their civic obligations. They may be in doubt as to the district in which they are entitled to cast their votes or the district in which they should send their children to school, as was found to be the case in a district boundary survey in Sussex County, Del. In this instance, with the cooperation of residents and use of historical records, the problem was solved satisfactorily for all concerned. Gratifying as the clearing up of a boundary problem was to the people living in the area, it was not the immediate objective for which the survey was made. To locate the district boundaries was a preliminary step in the determination of the land area of the districts (50).

Topographic quadrangles on the 1:24000 scale have appeared in recent years for some parts of the Eastern States. Judging from the issued quadrangles of this type, indefinite boundaries are more prevalent in the Appalachians than in any other part of the East.^{2/} Usually, the positions of State, county, and minor civil division boundaries and of public land held for specific uses are recorded on topographic quadrangles. These maps were examined to obtain recorded evidence on boundary uncertainties.

Tennessee is one of the States for which, at the time of writing, about 490 quadrangles on this scale, or 65 percent of those needed to cover the State, had been issued. Of this number, 124 quadrangles were found on which indefinite or approximate boundaries were indicated. About four-fifths of them are county boundaries. But even the location of boundaries along the Mississippi is not everywhere certain. Here, the meandering propensity of the river has produced stretches of indefinite State boundary between Arkansas and Tennessee. In the process of erosion and

^{2/} These maps are issued by the U. S. Geological Survey, Washington, D. C.

deposition, land was cut down in some places and built up in others; old bends in the river were cut off; and new bends were formed. As a result, tracts of land were created in which neither of the bordering States feels competent to enforce its own laws.

Other uncertain boundaries comprise the corporate limits of cities, the boundaries of State parks and forests, National Guard and Military Reservations, national parks, national forests, and wildlife-management areas. Most of these public lands were acquired from private owners. In the last two categories, not all the lands have been acquired, so that the outer boundary may represent only the limit of the purchase area within which the land can be acquired. But since the locations of private property boundaries are uncertain, the purchase limits cannot always be adjusted to coincide with established ownership boundaries, so that uncertain limits of purchase areas reflect local conditions.

Equally impressive is the evidence presented by the topographic quadrangles of Kentucky. For this State, all the 1:24000 scale quadrangles have been issued; they comprise in all some 710 sheets. Of these, 245 quadrangles, or nearly 35 percent, were found to contain indefinite or approximate boundaries, of which 194 were uncertain county boundaries. There are also stretches of indefinite State boundary. As in Tennessee, changes in the course of the Mississippi River have produced in places an indefinite State boundary, in this case, between Kentucky and Missouri. The longest stretch of indefinite State boundary is found, however, between Kentucky and Virginia, near the junction of the West Virginia, Kentucky, and Virginia lines. Next to county boundaries, indefinite corporate limits of cities are most numerous. In addition, State and National park boundaries are represented. Practically all of these quadrangles were issued after 1950; therefore, they represent present conditions. Some quadrangles issued 2 or 3 years earlier show the magisterial district lines in approximate position; in the revised edition, however, these lines were omitted.

Topographic survey maps on such large scales do not cover equally extensive areas in other southern Appalachian States. In fact, very few maps on this scale have appeared for some of them, so that the evidence that can be gleaned from these sources is fragmentary. What we have constitutes only samples, but even these samples indicate prevailing conditions.

For the State of Georgia, less than 100 quadrangles, clustered mainly in the northern and central parts, have appeared. From these, it seems that here too county boundaries provide the prevalent boundary uncertainties. In the North, a part of the State boundary between North Carolina and Georgia is marked as indefinite.

In South Carolina, this type of map is confined largely to the Lower Coastal Plain and a few Piedmont areas. On the Piedmont sheets, some uncertain county boundaries are noted.

More survey maps of this kind are available for North Carolina. About a third of the State is covered by large-scale maps. Distributionally, these quadrangles are concentrated more in the mountains and along the coast than in the Upper Coastal Plains and the Piedmont. In addition, some inch-to-the-mile scale maps issued during the last 10 years show uncertain boundaries. Most of the indefinite or approximate boundaries are township boundaries, but a number of county boundaries are so designated also.

A little more than a third of Virginia is covered by these large-scale topographic maps. They are concentrated mainly on the eastern lowland and the western highland. A few uncertain county, as well as national forest and reservation boundaries, are indicated. Moreover, on one of the smaller scale (1:62500) topographic maps, located on the West Virginia-Virginia line and issued in recent years, a stretch of indefinite State boundary is recorded. District boundaries as subdivisions of counties are not shown on the Virginia maps.

All of West Virginia has been surveyed on the scale of 1:62500, but very little has been done on the larger scale. What has been done is largely on quadrangles that straddle the Maryland and Kentucky boundaries. Therefore, the reference material is limited, but even on these few sheets uncertain district and county boundaries were noted in some instances.

Although all of Maryland and Delaware are covered by the 1:62500 and 1:31680 scale topographic quadrangles, only on the larger 1:24000 scale maps are a few of the approximate boundaries found. They pertain to districts, corporate limits of towns, and reservation and State park boundaries.

A similar situation prevails in Pennsylvania and New Jersey. Both States are covered by topographic surveys on the smaller scale, but uncertain boundaries become noticeable only after the appearance of the 1:24000 scale quadrangles. The indefinite or approximate boundaries recorded on these surveys are mainly township boundaries, but a few uncertain reservation, State park and forest, county, and boro boundaries are indicated also.

New York also is covered by small-scale topographic maps, and some of the uncertain boundaries were recorded on them. More came to light with the appearance of the 1:24000 scale quadrangles. County, town, and some reservation boundaries are found among the uncertain lines. These uncertain boundaries are found mainly in the central and northern parts of the State.

The New England States vary considerably as to the number of uncertain boundaries shown on their maps. None is noted in Massachusetts and Rhode Island. Most of Maine is covered on the 1:62500 scale; only a few of the 1:24000 scale quadrangles have appeared so far. Here, the land-surveying method of the settlement period is reflected in the strips and gores left as interstitial spaces between the political divisions. Misery Gore, in Somerset County, is an outstanding administrative anomaly of this kind. From its maximum eastern width of 3,000 feet, this wedge-shaped gore tapers gradually westward to a point 21.5 miles away; by doing so, it separates the adjoining townships to the north and south. Vermont and New Hampshire are completely surveyed on the 1:62500 scale. In New Hampshire, only one stretch of uncertain county boundary was found on the maps. In addition to the small-scale maps, Vermont has a few of the 1:24000 quadrangles, on which a number of county and township boundaries are labeled approximate. Finally, Connecticut has recent surveys on the 2-inch-to-the-mile scale, and on these some uncertain boundaries are noted. These uncertain stretches of boundaries include those of State parks and forests, as well as a township and a reservation boundary.

The checking of the published map material for the territory of early settlement in the Eastern United States revealed that there is no uniform distribution in category or number of indefinite or approximate administrative boundaries. A number of reasons can be adduced in explanation of these variations. That the evidence is so fragmentary and so unevenly distributed is due mainly to the incompleteness of the large-scale survey itself. But local conditions are reflected by the fact that in some instances the boundary uncertainties reported are confined to the county boundaries and in others are more prevalent among the minor civil divisions of the counties. In Tennessee and Kentucky, district boundaries are not even delimited, and probably we are not far amiss in assuming that, because in many instances they could not be located with any assurance of approximation, they were omitted altogether.

CONTEMPORARY NEEDS

The evidence of the prevailing boundary uncertainties in the Colonial Territory of the Eastern United States presented in the preceding pages applies to boundaries of privately owned real property and to boundaries of administrative political divisions. Because of the nature of the subject, the evidence can be presented only in the form of samples, but the samples are sufficient to indicate prevailing conditions. They also lead to a fuller understanding of the problems of government and that government cannot function properly unless it is implemented for the task.

In a democracy such as ours, the structure and organizational components of government are the concern of the people. Therefore, the people should have a rather definite concept of what is needed to operate local government, and of what is required to distribute its burdens fairly. So far, implementation of local government has remained largely a civil obligation of counties or communities. Consequently, it is contingent on the sources of revenue.

However, not all functions of local government can be classified as of purely local concern. With the recognition of this fact, modifications were introduced. Improvements that benefit the localities and the country as a whole, like the building of roads and highways, are now financed by the States and the Federal Government. Other local services are financed largely in this way, but the cadaster is not one of them, at least not for the eastern States that evolved from the colonies. The public domain States are an exception. From the beginning, they were equipped to deal effectively with questions of landownership.

When the problem of establishing spatial limits to the exercise of juridical rights is viewed in its entirety, it becomes obvious that its solution is not one of purely local concern. As indicated in the preceding pages, indefinite boundaries are found on all juridical levels, from the boundaries of privately owned land up to State boundaries, and all are interlocked. But boundaries are only one phase of modern cadaster plans. The quality of land is a feature of more than local significance. When land classification is included in the cadaster, it indicates the physical land resources of a region or country in regard to use capability.

Functionally, property boundaries and classification of land are closely related. Although the boundaries of rural real estate define its location and size, and with this

delimit the use rights of the owner, its physical attributes determine its quality and therefore its use capability. Consequently, size, location, and physical characteristics of rural real estate must be considered jointly to arrive at an equitable evaluation that fits into the prevailing social and economic structure of the region. To comprehend the spatial relationship of these factors in their natural setting requires their joint appearance on a reduced image in plano of the land area under consideration. The image used for this purpose may be in the form of a map or plan, or it may be an aerial photomosaic.

Land quality as it is used here is a conceptional term that connotes the human appraisal of the physical characteristics of the land as they affect productive use. Actually, the quality of land is determined by an aggregate of physical factors in which individual constituents vary in effectiveness, sometimes within short distances. All, however, operate in unison and all are interrelated.

The interrelationship of physical factors can be mentioned here only briefly. We find that the mineral contents of the soil were derived largely from the parent material – the weathered product of rock formations or deposits – from which the soil developed. The arrangement and structure of the underlying geologic formations also influenced the development of the physiographic surface features. Steepness or flatness of the land surface determines drainage. The arrangement of mountains and plains with reference to prevailing wind directions produces notable variations from latitudinal climate. In this way, it controls land use, not only directly through elevation and steepness of slope but over considerable areas indirectly through climate.

Throughout extensive regions, climate is the determining factor of how land can be used. But local distinctions produced by elevation and direction of slope exposure may also be sufficiently marked either to permit or to exclude some of the major land uses. Again, climate and water supply are related; they are prime factors in the development of the soil and the shaping of the biological environment as a whole. In addition, wind and water provide the operational energy in the mechanics of erosion and deposition of soil material. All of these factors contributed in various degree to the making and shaping of the land. All of them are still active agents that provide the conditions under which land use, as a human activity, must operate. With this as a premise, all deserve consideration when the land is under scrutiny to determine adaptability to productive use.

Necessarily, an analytical study of land use capability must take into consideration all the physical factors. This may make it seem desirable to visualize them graphically together. For technical reasons, such a treatment is not feasible. Each of these features requires a distinct symbolism in their graphic representation, which, when superimposed one upon the other would sacrifice clarity of expression and render them unintelligible. As an alternative, a land classification may be suggested. Several land-classification schemes have been propounded, but none can be considered as having an adequate foundation if it is not based on the soils.

In this respect, soils are a unique medium in which the physical conditions of the land are recorded to a considerable extent. Site variations in texture, structure, depth, chemical composition, and color in the successive layers of the soil profiles

are due to differences in parent material and to the operation of the soil-forming processes. Geologic formation, climate, land relief, and the vegetative cover under which the soils developed have left their imprints on the soil profiles. These are the distinctions that reveal the quality of the land. Use capability of the land, its productive capacity, the adequacy or need of available plant nutrients, excess or deficiency of drainage, and in the case of cultural uses, the requirements of proper soil-management practices, are all indices of land quality that are reflected in the nature of the soil. The condition of the soil cannot be ignored, therefore, in land valuation or in the potential use appraisal of the land. This is true also when adjustments in land use to conserve the soil, to increase production, or both, are in question (38, 35, 61, 70).

Inclusion of the soil as part of a cadaster survey has become essential with the expansion of the service a cadaster is presumed to render. As an implement of government, the soils, or a land classification based on the soils, is needed in a cadaster to provide a sound foundation for an equitable tax assessment of the land. On the official, semiofficial or private level, knowledge of the soils is needed when the land is used as mortgage security, or when the cadaster serves the purpose of planning for future needs.

Public works – highways, airports, rights-of-way for power and pipe lines, industrial site development, urban expansion, development by hydraulic power sites, or installation of drainage or irrigated systems – are all improvements that affect private property and use of the land. All must start planning at the landownership level, and all must consider land values. Projects of this kind cannot obtain all needed background information from a cadaster that contains only property lines and soils. Cadaster maps of this kind do not reveal how many cubic yards of earth must be moved in the grading of a roadbed, how much land will be inundated by a dam across a valley of a certain elevation, or how drainage channels should be placed to permit adequate drainage of the land. Neither do such maps reveal whether or not there are any subsurface resources of economic value in the area. When special information of this kind is needed, supplemental surveys are required, but the cultural features and drainage channels of a properly constructed cadaster map can provide the ground plan.

In the evolution of the cultural landscape, the works of man require continuous modifications and improvements to keep pace with the advancing needs of the people. Changes in landownership and use must be expected, therefore, but these adjustments to internal growth pose complex problems that require study of local conditions. Most of these changes affect private property, so that the cadaster has acquired new functions that should find full recognition when the organization of one is in question. As an implement of planning for future needs, its functional qualifications must be part of the structural design of the cadaster itself in order to equip it for the purposes it is intended to serve.

THE STANDARD REMEDY

Although the cadaster is an ancient implement of government, its fundamental concepts are now as sound as they were at the time the first one was organized. Time has not diminished its value as an administrative tool. On the contrary, with the

more intensified and diversified use of the land, the functions of the cadaster have been expanded and its value as an objective legal record of the land enhanced.

An equitable distribution of the tax burden imposed on landowners, security in the right to own and use the land, and civic unity and order in the community were the avowed purposes of the cadaster from the beginning, even though they were not always attained. To a large extent, any shortcomings in reaching these objectives were due to the imperfections of the cadastral records themselves. So long as the land records were derived from nothing more than declarations of the landowners, inconsistencies could not be avoided, no matter how conscientiously these declarations were made. Only actual surveys can determine boundary locations and areal dimensions. Without such surveys and the resulting maps, no cadaster can function properly.

Experiences of this kind were not unique to the territory of early settlement in the eastern United States. Most of the land in the Old World was occupied and developed without any preestablished land divisions. In many instances, property boundaries were as haphazardly placed and as indefinite in location as they were in the Colonial Territory. To eliminate these deficiencies and improve the administration of land taxes, boundary uncertainties and disputes had to be resolved and boundaries marked properly on the ground. Only when property boundaries are clearly identifiable in the field can a cadaster survey be made with boundaries delimited on the maps to serve as evidence of their location and the extent of individual ownership of the land.

The primary purpose of the older cadaster surveys was to obtain an official record of landownership with boundaries delimited and areas properly determined. Such a restricted treatment of the surveys produced the evidence of landownership that could be used as the foundation of the land-tax register. Therefore, the utility of these surveys was limited to the identification of landownership, which is inadequate to cope with present conditions. An increase in population necessarily produces intensification and diversification of land uses, which affect landowners. In planning these adjustments to meet the needs of a changing world, the cadaster can furnish fundamental information, provided it is equipped for these expanded and diversified functions. This may appear to be a novel design for a cadaster, but in reality, it is a century-old concept of what a cadaster should be. The previously quoted recommendations of the first International Statistical Congress in 1853 specified this. Experience has substantiated the soundness of the recommendation.

Compliance with the specifications enunciated in 1853 is conditioned on the contents of the cadaster plans or maps. This in itself indicates that a cadaster plan must contain more than the outlines of properties. As pointed out earlier, such a one-sided treatment cannot furnish the fundamental facts needed for an equitable appraisal of rural property for taxing purposes, in determining its sales value, or when the property is used as mortgage security. In planning adjustments in land use to conform to changed needs, all the relevant features provide essential background information for the location of engineering works or land use improvements.

Cadastral requirements should not be considered as uniform throughout the country. The higher standards and diversity in functional contents are justifiable

only in areas in which the resource base itself permits more than a widely scattered settlement. Obviously, no detailed large-scale ownership map and detailed soil survey is needed for a desert, except where irrigation is installed. In the eastern United States, extensive tracts of rugged mountain land in public ownership fall into a similar category. Public ownership of land means that it has a designated use that is not likely to change, whether it be forestry, wildlife sanctuary, or recreation ground. Besides, all these areas serve as catchment areas of precipitation to supply the water needed on the lower levels. But what is needed, in many instances, are well-marked boundary lines of the public lands.

In recent years, much topographic and soil mapping has been done in this part of the country, yet farmers and landowners do not get the full benefit from it. The scale of these maps is too small and landlines are not indicated. As a result, landowners cannot identify their properties. When changes in the productive use of privately owned land are contemplated, they must be undertaken by the owners or operators. Knowledge of how soils are distributed over the property will permit land use to be adjusted accordingly.

To overcome this deficiency, special soil surveys are now made on aerial photographs of individual or groups of farms, but these soil surveys do not qualify for cadaster use. They do not resolve boundary disputes or uncertainties; they have no legal status in affirming the correctness of the boundaries; nor are they recorded in a legal register. Furthermore, the scale of these photographs is not uniform enough to permit an offhand joining to obtain a working base for a more extensive area. How the two functions can be combined to complement each other and to enhance and expand their utility is discussed later.

Landownership and land use are not fixed and stable in all parts of the country. This is particularly true when applied to the eastern United States. The densest aggregation of people is found in this part of the country, and it is here that the greatest increase in population may be expected. Changes in ownership and use of land will be associated with the increase. The trend in this direction is already in evidence. In the environs of cities, along the highways, on the seaboard, and in the broader valleys among the mountains, the cultural landscape is forever changing. New industrial districts appear also in other favorable places.

That the major growth of population in the United States will occur in the eastern half of the country is more than a conjecture. This forecast is founded on the resource potentiality of the region to absorb and support a greater number of people. The critical element is water. Aside from some of the more restricted areas in the West, only in the humid East does an adequate water supply permit further development of such magnitude as to accommodate a significant increase in population. Nevertheless, water management is essential; it involves the collecting and storing of water for additional industries, and at the same time of providing water for the domestic needs of a greater concentration of people. Moreover, there still is more physically suitable land which, with improvements, would permit a considerable expansion of primary production. With these prospects as background, it is evident that the further development of the humid region carries with it far-reaching socio-economic implications and civil responsibilities.

Further development of the territory of early settlement in the eastern United States poses in this respect a problem of its own. In contrast to the public domain areas, which were systematically divided into tracts before they were settled, this part of the country was settled almost entirely without any preconceived order in space. A crazy quilt pattern of landownership resulted from it and furnished the foundation on which new development must take place. Usually, changes in landownership are necessary antecedents to new development, but uncertain boundaries and therefore cloudy titles frequently complicate these procedures.

Changes in landownership may be viewed from two different angles, one in which privately owned land is acquired for public use and the other in which individual ownership may change but the land remains privately owned.

In the first category fall the numerous public service projects that are part and parcel of areal development. Additional highways and roads, airports, reservoirs, parks, school grounds, and rights-of-way for power and pipe lines are public service appurtenances which with an increase in population will need to be fitted into the existing cultural landscape pattern. All require transfer of land titles or use easements to public agencies or public service organizations.

On the private level, changes in landownership will be needed when development of industrial sites and urban expansion are involved. In some parts of the southern Piedmont, fragmentation of estates is also a reason. In these instances, repeated partitioning of estates among the heirs of deceased owners has reached a point at which individual tracts are frequently too small to support a farmer. Consolidation of these parcels would be necessary to produce economic farm units. Because of the diversity of interest of the present owners, and the irregular distribution of arable land, such a process is beset with difficulties (33, pp. 48-57). Similarly, if the forest industry is to be placed on a permanent footing, mill operators will need to acquire ownership or control of sufficient forest land to insure sustained operations.

With an increase in population, changes in land use and ownership must be expected and accepted, but future development should not be left entirely to the vagaries of chance. A certain amount of foresight and planning is desirable to safeguard public welfare by keeping in mind the needs of future generations. Only a few of the more important demands on land that arise from growth of population can be pointed out here. These demands should receive prior consideration to provide a guiding orientation above the conflicting interests of individuals.

By using the present trend as an indicator of things to come, it is safe to assume that industrialization and urbanization of population will continue. What could be changed to a greater degree is the distributional trend. Industrial plants could be well distributed throughout the area to create employment opportunities within the environs in which the people live. Industrial sites need to meet such qualifications as transportation facilities, accessible raw material, energy, and water supply. Land suited to agricultural production could be preserved for that purpose. Another preceptive guard would be to keep reservoir sites and periodically flooded bottom lands free from encroaching settlement or industrial occupation.

Frequently, land uses are not only competitive but objectionable. In evaluating the cultural landscape, the demand for land is often prescribed to such an extent that a study of location advantage and shortcomings is necessary to decide the issue. Most of these changes or improvements affect private property, so that a cadaster can offer considerable help by revealing at a glance the distribution of different kinds of land and its ownership. When used for that purpose, the cadaster acquires a new function that should be fully recognized when a cadaster organization is in question. As an implement of planning for future needs, its functional qualifications must be part of its structural design in order to equip it for the purpose it is intended to serve.

THE OLD REMEDY IN A NEW GUISE

That cadaster surveys are a real necessity is attested in the history of their development in the Old World. Aside from the Roman colonial settlements, settlement in western European countries was not controlled by a preconceived system of geometric regularity, nor was it planned with the assistance of qualified surveyors. Although division and allocation of land among the people was not strictly regulated, certain types of settlement evolved. The closed-village type is one; settlers located along a road is another; and the openly scattered settlement is a third pattern. Local concepts of location advantages, which are frequently associated with and derived from, physical conditions, were probably the determining factors of land allocation outside the larger feudalestates. That under these circumstances similar problems made their appearance, as found in the territory of early settlement in the eastern United States, was inevitable. It became apparent also that the uncertainties in landownership affected the efficient discharge of the administrative functions of government. Without factual records, an equitable assessment of landed property was next to impossible.

Cadaster surveys started in Europe in a number of the smaller political divisions. However, with the consolidation of the smaller juridical units into larger States, a proper procedure of tax assessment became a national obligation. Furthermore, in order to attain a uniform standard of accuracy and execution, to obtain coherence in coverage, and to keep cadaster plans currently evident, a national organization was needed. As a result, in most of the European countries, the cadaster became national in scope and organization.

In the main, these surveys were concerned with defining and recording the boundaries of landownership, although community and district boundaries, roads, houses, mills, wharves, watercourses, and so on were included. Uncertain property boundaries frequently had to be resolved before they could be recorded on the cadaster plans. In this way, location and areal dimensions of individual properties were determined and recorded, thus providing definite evidence of landownership, one of the essential factors in establishing a tax register.

Plane table surveying was the prevailing method used. For the most part, it was begun without adequate horizontal control in the form of primary and secondary triangulation. In some countries, the work was not far advanced, before it became apparent that overall horizontal control was needed to obtain areal coherence and continuity. England was one of the first countries to adopt triangulation control. As a result, the cadaster plans furnished the foundation for all the other official maps of the country.

Identifying, measuring, and recording the location, boundaries and size of landholdings, was the first concern of the cadaster, in that it delimited the rights of land use. At the same time, it established fiscal obligations but without determining or directly indicating their proportions, which is or should be an expression of land value. When land is used for primary production, aside from degree of development and location advantages, land value hinges to a large extent on the quality of the land itself.

To obtain some measure of quality, several indicators were relied upon. Average estimates of yield per areal unit, amount of seed used per areal unit to obtain the best yields, number of head of livestock kept by the operator, and type of vegetation growing on the land are some of them. Character of soil was noted empirically at times. Although these indices are related to the productivity of the land, their origins were largely of a traditional nature; they were not derived from systematic observations and classifications. As a consequence, no valid interrelationship or synthesis could be established or made between different places. Only after soil characteristics were properly defined to permit classification was it possible to correlate the other factors affecting land value, and to devise an integrated land-appraisal procedure for practical application (66).

Farm appraisal procedure, however, is only one of the beneficiaries in which soil classification contributed to the solving of administrative problems.

In many parts of Western Europe, where the land has been settled and cultivated for many centuries, farms have become greatly fractionalized. In this instance, fragmentation means more than division of the land into smaller units; often it produces a cultural landscape composed of small fields, each belonging to a different farm. Such a complex arrangement of landownership impedes efficient farm operations and prevents the use of mechanized equipment.

To eliminate this handicap and increase production, consolidation of these parcels is essential; it is now in progress in these countries. Exchange of land parcels is involved in the procedure, which again takes into consideration not only the size and location of the parcels but the character of the soil as well (30). This is another illustration of the value of the cadaster, for without it, the many problems connected with such an involved situation in landownership could hardly be solved.

From the uses made of the cadaster, it is evident that the factual information contained in the plans and records has served a variety of purposes and justifies a cadaster on more than one account. Moreover, with our improved technique in surveying, which includes the use of aerial photography, the contents of the cadaster plans have been enriched and their utilitarian value increased. In Europe, the first coverage of cadaster surveys was largely completed before aerial photography came into use, so that all the features appearing on the plans had to be located from ground observations in the field. As may be surmised, this required considerably more fieldwork than is needed with aerial photography.

Aerial photographs are now used extensively in the work of many departments of Federal, State, and local governments. Private organizations are using them also to a considerable extent. But they are often used for rather limited areas, without

requiring measurements on the photographic images that yield results of a definite degree of accuracy. When used for cadastral surveys, the specifications of accuracy must necessarily be of a higher order. Here the location of boundary markers and of all other features must appear in true horizontal relationship to each other, so that distance and areal measures can be obtained with a minimum of error.

Contact prints of vertical aerial photographs cannot be joined directly to obtain a coherent picture of a more extensive area. Tilt always produces some variations in scale and differences in flight and ground elevations must be corrected also. To accomplish this, horizontal control points, or triangulation stations as they are called, are established. Their position with reference to latitude and longitude, their bearing, and the distance from each other are defined with precision. In the United States, a net of triangulation stations with permanent markers set in the ground has been established, but frequently these stations must be supplemented by traverse stations for large-scale surveys. The positions of these stations are defined with reference to the figure of the earth, which in this connection is usually called a geoid, or an ellipsoid of revolution. The establishment of these horizontal control points is a function of the Geodetic Survey.

Computations of positions based on the geoid or sea-level surface of the earth are complex and tedious and not all land surveyors are familiar with them. In their survey operations, most surveyors apply plane trigonometry in computing the position of boundary markers. To facilitate the use of the national horizontal control stations in the work of land surveyors, the State Coordinate System was developed. This required the projection of the all-side curved surface of the earth onto a plane surface, which cannot be accomplished without distortions. The magnitude of these distortions increases with the size of the area involved. In order to hold the distortions to a minimum, the State Coordinate Systems are confined to either latitudinal or longitudinal zones and projected on conal or cylindrical surfaces, which can be flattened out without further distortions. Furthermore, to preserve the unity of political subdivisions, these belts are adjusted to and delimited by county boundaries. The smaller States are contained in one belt; the larger ones are divided into two or more belts (59).

Projecting the earth's surface upon the plane surface is done by using the graticule formed by the parallels and meridians. These projections in turn provide the foundations on which the grids of the plane rectangular coordinate systems are applied. In this way, the geodetic positions of the horizontal control stations also can be transformed into rectangular coordinates of the systems. Differences in distance between points on the earth's surface and the same points as defined in position by the rectangular coordinates that arise from the projections are small, usually less than one part in 10,000. Thus for most practical purposes, they are negligible. Differences in bearing of control stations to each other become expressible only when the spherical triangles are large enough to register a measurable spherical excess.

The State Coordinate Systems were introduced more than a quarter of a century ago; they have been worked out for all the States. Many of the States adopted the systems as a legal device to define the position of boundary markers. This is particularly true of the Eastern States that evolved from the territory of early settlement

and were not included in the public domain. In all except four of these States — Kentucky, New Hampshire, South Carolina, and West Virginia — the State coordinate systems have received legal recognition. Their use is not obligatory, but their employment in property surveys is frequently encouraged by the States.

As a method of defining property boundaries, the State Coordinate Systems have been used so far mainly in surveys of individual tracts or in some cases in surveys of suburban land divisions. So long as this remains the customary use of these systems, we cannot expect that ultimately whole States be covered by such surveys. Even under the assumption that this could happen, the benefits derived from them would still be limited in scope and extent.

An enhancement and expansion of the utilitarian value of the cadaster plans, to meet the requirements of our time, is dependent upon their precision and contents. Precision in areal definition is one of the functional requirements to acreage determination. Furthermore, the cadaster plans must be conceived as composite wholes of ownership divisions and quality distinctions of the land. Location, size, and quality of rural real estate are the elements on which its value is based. To clear up boundary uncertainties, and at the same time obtain the benefits mentioned, requires systematic coverage of all the States in which the metes and bounds surveys were applied.

Measurements derived from cadaster plans are not confined to acreages of properties; they extend also to the civil divisions of the county. Areal measures have a wide range in application; consequently, they should be consistent among themselves. Land titles, tax assessment, and value appraisal for mortgage security require knowledge of the acreages of land holdings. Reliable areal statistics of civil divisions are needed also to serve as a foundation for the study of land use and its changes, to provide a reliable basis for land inventories, and for the economic analysis of areal conditions. All of these areal measures of land are related (50).

We are dealing, therefore, with two major technical innovations that cannot be ignored if we wish to reap the benefits derived from their use. Survey operations executed with these modern tools should be organized so that they can be applied jointly. When this requisite is explored, it is found that there are few alternatives from which to choose. The most effective way of combining the two innovations is to construct aerial photomosaics controlled in their position by the location of triangulation stations as they appear on the State Coordinate Systems. By so doing, the images of the photographs are adjusted not only to the control points provided by triangulation but to the rectangular coordinate systems as well.

A good many advantages accrue from this procedure. Field surveys of formerly uncertain but resolved boundaries that cannot be identified on the photographs can be transferred readily to the mosaic. Soil surveys also require field investigation, which is greatly facilitated by the use of aerial photographs. The surface features are represented in the photographs in considerable detail, and consequently they provide a ready reference for a close identification of position. Cadaster plans produced on a controlled aerial photo background obviously contain a great many other features. Land use is one that will increase their utilitarian value but will change also their conventionalized appearance.

BOUNDARY DETERMINATION

Boundaries defined by such distinct features as roads, fences, hedges, creeks or ditches, and not in dispute, are easiest to locate and to delimit on the aerial mosaic. But boundary descriptions based on the original metes and bounds surveys are often difficult to identify. As a rule, no permanent markers were established, nor were the boundaries of prior land titles always checked to avoid conflicts with neighboring claims. As a result, boundary disputes still form one of the greatest drawbacks to the recording of rights of ownership, and they are an impediment to the proper discharge of the function of local government. But insecurity in property rights is frustrating to landowners and disturbs the peace of mind of those concerned.

Many of the original boundary uncertainties have been cleared up through court action. Transfer of title, or a mortgage application, usually revealed the shortcomings of boundary definition, and with it the impaired rights of the owner. To provide greater title security than the antiquated land description could do, indefinite boundaries had to be defined clearly to eliminate disputes. Necessarily, the adjudication, survey, and description of the boundary location were made under the direction of the court.

The method of recording titles, as inherited from the settlement period, rests on boundary descriptions. In order to facilitate and improve the method of title transfer, and increase security in landownership, the registration system, better known as the Torrens system, was legalized in a number of States. Of those States that accepted it legally up to 1948, eight, if Ohio is included, are part of the Colonial Territory (60, p. 73).

Under the provisions of the Torrens system, the State guarantees the title to the land and consequently requires proper boundary definitions and surveys of the properties. In Massachusetts, a special land court was established in 1898, to administer the Torrens system, which some years ago adopted the State coordinate system as the term of reference in boundary surveys.

On the whole, the Torrens system has not found widespread application. Even though it is legalized, it is not obligatory. Application of the Torrens system must be initiated by petitioning the court, and the petitioner must bear the cost. Now, with half a century of experience back of it, indications are that a universal application of the Torrens system cannot be expected. Actually, the Torrens system was not designed to provide an administrative tool with multiple functions. As conceived, its objective is too narrow in scope to serve more than the personal interest of a landowner in the security of his land title.

Cadaster plans and registers are presumed to contain the relevant information pertaining to ownership and quality of all the land. All landowners benefit from a cadaster, and thus the welfare of communities and of the State as a whole is promoted. It should be clear that a cadaster cannot function if its plans contain boundaries labeled "indefinite" or "approximate," as is found on topographic maps. Neither can overlapping claims be recorded as such.

Pointing out boundary defects without solving them would be contrary to the function and scope of the cadaster. Uncertainties in property boundaries must be resolved, because the cadaster is the instrument that contains the evidence of the limits of ownership rights, and at the same time provides the foundation to determine the obligations of ownership. With property boundaries defined, the background reference for the location and determination of civil division boundaries is secured. Clearing up boundary disputes, therefore, is one of the first requisites to a systematic cadaster survey.

Solving all boundary problems through conventionalized court action would be a prodigious task for the courts to handle. To avoid congesting the courts with boundary cases and to expedite the process will require a somewhat different approach, which nevertheless must have full legal status.

An example of how this can be done was cited in the discussion of the Italian cadaster (p. 18). A similar procedure, although more cumbersome, has been in force in France since 1898. There, the investigation and determination of property boundaries in dispute is done by a committee of 14 members. The committee is presided over by the mayor of the community, or a member of the municipal council as his delegate. The committee itself is composed of eight proprietors of the community in which the disputed boundary is located, and at least two proprietors from other communities. In addition, a justice of the peace or a notary public is assigned to the committee by the prefect of the canton, and an agent of the cadaster administration is assigned to the committee by its director. Furthermore, a surveyor may join the committee and take part in its deliberations (29, pp. 179-181).

When the mechanics of arbitration are considered to be applicable to the conditions found in eastern United States, a certain amount of preliminary work is required to find out the different aspects of the boundary problems. First, the properties with uncertain boundaries would need to be located and the original boundary descriptions compared and retraced on the ground, if possible. Nonresident landowners pose their own problem. Tax delinquency also may have a bearing on the issue, as may multiple ownership. The latter may apply to land owned by a corporate organization, or it may represent an unsettled estate. If it is an unsettled estate, an arbitrated boundary decision would require written acceptance by all concerned. When the heirs are scattered over the country, this may be complicated. These are some of the obstacles that must be cleared in defining boundaries so they can be recorded as established on the plans. As may be perceived, this is a time-consuming process, which has found expression in the French maxim, "Surveying a well-marked boundary is half the work."

BOUNDARY MARKERS

Obviously, a boundary determination is transitory without its demarcation through permanent markers on the ground. These markers provide not only visible evidence of the boundary in the field; they provide also definite points of reference to which the boundary description can be tied. The permanency of these markers, therefore, is necessary to the retention of their value as signposts to indicate where the rights of one owner end and those of the neighbor begin. Lost boundary markers frequently are the source of boundary uncertainties and disputes.

Boundary markers are not new. Usually, they were protected by legal provisions against defacement, removal, or change in position. Boundary markers were known as far back as Babylonian times. The ancient Egyptians had boundary markers that indicated district boundaries, of which some still exist today. One of the curses of Mount Hebal is directly concerned with the Israelitic landmarks, as the boundary markers are called in the Bible. "Cursed be he that removeth his neighbor's landmarks" (Deut. ch. XXVII, 17) leaves little doubt that they were in common use at that time.

The Romans in particular held them in high regard. To assure permanency to the markers, they resorted to stratagems. Boundary markers of the Romans usually consisted of hewn stones set into the ground. In order to prevent fraudulent land appropriations, the stones were frequently obtained from distant quarries having rock formations of a different petrographic nature than those found in the vicinity. The Romans sometimes buried under the stones secret identification devices of position, such as figurines and potsherds, that resisted decay. For maximum protection of the boundary markers, the Romans included them in their religious cults. Deus Terminus was the deity relied on to guard boundaries, particularly boundary markers. Some of the boundary markers themselves reveal the connection. These markers were more of the monumental type; they exhibited the sculptured image of Deus Terminus and in cut letters contained an imprecation against anyone who attempted to destroy or displace them (42, pp. 123-125).

In Central Europe, boundary markers of property lines usually consist of stones set into the ground, of which the upper end is roughly 4 inches square and protrudes a few inches above the surface. As an indication that these stones are boundary markers, they usually contain on the upper face a cut-in cross. The custom of marking the boundary stones in this way is probably a legacy of the Romans, as they marked their boundary stones similarly. A turning point in the boundary between two owners was marked with one angle; the junction point of three properties was demarked with a trihedral figure; and a common corner of four properties was marked with a cross.

As a rule, in the territory of early settlement in the eastern United States, the original surveys of property boundaries left no permanent markers or monuments on the ground. Nearly the whole area was wooded before the land was taken up by settlers, and the metes and bounds descriptions of the boundaries were frequently tied to trees. The trees were named according to species and might or might not be blazed by chipping off a piece of the bark. But other objects that attracted the eyes of the surveyors were used at times. Sherman cites an example he found in eastern Kentucky while he was surveying there. In one of the deeds, the point of beginning of the boundary description was indicated as being at "the old crow's nest on the north fork of Kentucky River (67, p. 31)." Similar boundary descriptions were found by Haren in Fluvanna County, Va. (33, p. 47).

The original boundary surveys and descriptions were therefore rather loosely conceived and executed. Few of the testimonial marks mentioned in the descriptions as identifying the location of the boundaries were sufficiently permanent to last for generations. Blazes on trees grew over with new bark that could be detected only through close inspection and that needed dissection for verification. But probably the

trees themselves were cut either for lumber or to clear the land. Even shortly after the boundary lines were run, the marks were not readily discernible and recognized by later surveying parties. As a result, issuance of overlapping patents was frequent.

With the settlement and development of the country, however, property boundaries had to be recognized, especially where the land was cleared and used for farming. Fences were built; balk ridges were left; hedges grew up; or stones collected from the fields were piled up in corners or placed along boundary lines. Usually, when these boundary signs are accepted by neighbors as conforming to their own claims, they may be considered as established and may be recorded in this way. But when doubt exists, search of records and field investigations to verify the location of the boundary and permanent boundary markers are necessary.

THE SCALE

The scale of cadaster plans, as a project question, deserves consideration because it affects the functional capabilities of the cadaster itself. If the plan is too small, the recording capacity and clarity of expression is reduced, and when it is enlarged, the initial and maintenance costs are increased. Other considerations are involved so that no universal valid answer is available.

In countries using the English system of measures, the differences of opinion naturally revolve around two main questions. One is the use of the decimal ratio versus a ratio derived from the English system of measures. Another is the scale ratio in relation to the prevalent size of the land holdings themselves. The scale, therefore, is a subject on which opinions and practical considerations may clash. In England, it took 10 years during the formation period to decide the issue, which is sometimes referred to as "the battle of the scales." In this particular case, the decision reached was in favor of the binary or decimal relationship of 1:2500. The resulting plans cover an area of one kilometer square; they contain rectangular grid lines at 100-meter intervals. The size of rural land holdings, however, is recorded in acres. This arrangement applies only to the large-scale plans. Usually, on the smaller scale series of maps, the scale is expressed in inches or fractions of an inch to the mile. Two exceptions must be noted – one is the 1:500,000 map, the other is the million-scale map.

In continental Europe, this type of scale complication no longer exists. All of these countries have adopted the decimal system of measures, and the cadaster and other maps are now on natural scales. The cadaster scales range in these countries from 1:2000 to 1:4000 or 1:5000 and smaller.

The situation in the United States is similar to that in England. The English measures still are the official norm; the metric system is optional. However, use of the metric system is gaining ground, especially in scientific circles and in industries in which a great deal of measuring and computing work is done. If this trend continues, there is a possibility that the official status of the two systems may some day be reversed. Our official map scales reflect the dual use status of the English and metric measures. We have one official map series on the scale of 1:24000, in which one inch represents 2,000 feet; and another series on the scale of 1:25000, in which

one centimeter on the map represents 25,000 centimeters, or 250 meters, in nature. These are the larger scales used for topographic mapping. On some, the scale may be $1'' = 660'$, which conforms to the ratio 1:7920. Compared with scales of European cadaster plans, this is smaller; it indicates that, as a rule, our rural real estate holdings are larger than those in Europe.

Within the bounds of the territory of early settlement, the prevalent size of rural land holdings is not uniform for all States. The scale, therefore, would need to be decided by each State, but it should remain constant within the State.

CONCLUSION

From the preceding discussion of the cadaster, its history, development and functions, it should be evident that in the older countries a cadaster is regarded as an essential implement for efficient government. Through application of established principles, a fair and equitable assessment of real property is made possible. But the operational benefits of a cadaster are not confined to administration alone. The influence of a cadaster extends into the everyday life of the community, in that it tends to create, so far as land questions are concerned, an atmosphere of security, order, and good will among the people.

A cadaster considered from the viewpoint of contemporary requirements would not be executed as it was a century ago. With the scientific and technical advances of our time, new elements will find recognition in its structural design. The State coordinate system is one of them. Aerial photography as a feature-recording technique is another. A third is its multipurpose function.

Title security and value appraisal of the land are the chief functions of the older cadaster. The broadening of the scope of the cadaster affects chiefly the cadaster plans. When executed according to the requirements indicated, the groundplans can contain all the needed administrative information on landownership and can also serve as a guide to rational development and adjustment of the use of the land. This applies to the needs of landowners and of the country as a whole. To accomplish this, the graphic delimitation of the physical use capability of the land is an essential element of the plans; it is contingent on soil or land classification as developed by soil specialists.

Obviously, such plans pose a problem that can be solved only through the integrated action of scientific, technical, legal, and administrative knowledge and skills. Nor can the problem be solved economically if the organizational unit is conceived of as confined to a relatively small political subdivision.

As at present organized, counties are the usual political units that assess and collect taxes on land. The uncertain property boundaries that await determination and recording are confined largely to rural environs. This is one of the chief handicaps to consideration of a county as an independent organizational unit of a cadaster, in that counties lack the equipment and the financial resources required.

Another drawback is provided by the boundaries themselves in that frequently political and property boundaries are not coterminous. That is to say, political boundaries do not always follow property lines. In some instances, adjustment to permit them to do so would be not only feasible but beneficial; it would simplify administrative procedures and unify the obligations of landowners.

That counties are not suitable units for organization of a cadaster is not a hypothetical statement; it is supported by experience. Since 1943, Pennsylvania has tried to establish a permanent tax-record system with some of the functions of a cadaster. This act of the State Legislature was amended, however, in 1947, and again in 1951. The last amendment is known as "the Fourth to Eighth Class County Assessment Law;" it applies to all except eight of the predominantly urbanized counties in Pennsylvania (40).

This law required that within 5 years the counties affected establish a permanent system of assessment records to consist of tax maps, property record cards, and a property owners' index. A survey made in the fall of 1955 revealed that only 4 counties had completed the work and installed the system, 27 had made some progress toward installation, and 28 had made none. The deadline for completion was advanced. No final report has appeared so far, and an account of the situation as of May 1957 showed no prospect that all counties would be able to finish the project by the end of the year. Actually, 20 counties had not even started to map the tax units (39). As a case in point, this procedure indicates that a simple delegation of responsibility to the counties does not provide the solution of a complex problem.

As a statewide organization forming part of the State government, the cadaster would have a unifying office at the State capital, from which operational procedures can be directed and technical problems solved. This office should be equipped to house and keep on file all the original plans and documents and produce additional copies when needed. It should be charged also with the responsibility of keeping them up to date.

The greatest use potentiality and service demands, however, would develop in the counties. Each county should have at least one complete set of cadaster records on file. Aside from the utilitarian considerations of dual deposits, an element of safety, which was recognized by the ancient Egyptians, is involved. In case one set of documents is destroyed, it can be duplicated from the second.

An additional point should be kept in mind. A cadaster cannot be organized, executed, and put into service without the active assistance and cooperation of the people themselves. It is essential that the aims and purposes of a cadaster be understood by the people. They must be convinced that their rights and problems will receive open, fair, and impartial consideration, and that the cadaster is designed to serve, not individual interests but the common welfare of the community and the State.

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